D. M. Dunlop

Arabic Science in the West

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By

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PREFACE

The following pages are for the most part closely written—too closely written, one fears, to make altogether agreeable reading. They contain a great many facts, or what the author takes to be facts, about a relatively neglected aspect of the intellectual history of Europe, the reception of Arabic science by the West in the Middle Ages. Yet the intention is not to offer anything like an exhaustive, factual account of what then took place, for which a little book of this size is in any case far too small. The fullest possible information on the translators from Arabic into Latin, the works translated and the more or less original compositions to which they gave rise, is to be obtained from the writings of the nineteenth century masters, Jourdain and Steinschneider, supplemented in the present century by George Sarton and others, notably several gifted contributors to the periodical *Al-Andalus*. Yet, while these authors are repeatedly cited in the present work, it is not a *rechauffe* or a *resume* of what has already been written, but a modest attempt to do something new, viz., to interpret the bare data and present the transmission of Arabic science to Europe as an organic movement, so to say, extending from the tenth to the seventeenth century and exhibiting the ordinary features of growth and decline.

Some of the questions here discussed have been present to my mind for a number of years. An opportunity came for putting together such ideas as I had on the subject when I was invited by the History of Science Committee of Cambridge University to give a course of four lectures on Arabic science under its auspices in the Lent Term of 1953. The four main chapters of the present book correspond to this original division, but have been modified considerably since they were first written down.

The suggestion that the work might be published by the Pakistan Historical Society was made originally by my former teacher, Professor Paul E. Kahle of Oxford, to whom, as time passes, my obligations increase rather than diminish. His proposal was seconded by Dr. S. Moinul Haq of Karachi, who has done everything in his power to see the present work, first, through the pages of the *Journal of the Pakistan*

Historical Society (1957) and now into book form. I am glad to have an opportunity of thanking him publicly for his help.

At the request of the Executive Committee of the Society, I have added an introductory essay with the title 'The Scientific Heritage of Islam'.

Both publishers and author much regret that it has not been possible to insert French and Spanish accents and other diacritical signs, except in a limited number of cases. It is hoped that this will not be found a serious obstacle to readers.

D. M. D.

Cambridge, 11 *July*, 1958.

INTRODUCTION

THE SCIENTIFIC HERITAGE OF ISLAM

The subject of Arabic science is a very extensive one, and to attempt even to outline it within the limits of an introductory essay would result in a bare catalogue of authors and their works. Such a catalogue makes tedious reading, and instead I am proposing to consider several departments of knowledge for which there is substantial material in Arabic: alchemy (or, if one prefers it, chemistry), mathematics, astrology and astronomy, medicine, etc. Without pretending to deal with any of these systematically, I shall offer some considerations which appear to be interesting or significant, and in this way try to suggest an over-all picture of what the scientific effort in Islam amounted to. The method is frankly impressionistic. A straight picture may readily be got from the excellent books on Arabic science, written within recent decades, which we are now fortunate enough to possess.[1]

In a study of this kind the beginnings always have a special interest, and to them we must devote some of the available space. One or another of the sciences may have been known to the Arabs before Islam, though we have to wait, in every case, till considerably later than the first preaching of the new religion for their florescence. The pre-Islamic Arabs doubtless knew something about the heavenly bodies and had apparently already given names to the five planets: 'Uṭārid (Mercury), az-Zuharah (Venus), al-Mirrīkh (Mars), al-Mushtarī (Jupiter) and Zuḥal (Saturn). 'Uṭārid, for instance, is found in the Jāhilīyah as a personal name.[2] All these names can easily be derived from Arabic roots and do not give the impression of being foreign borrowings.

[1] In addition to the relevant parts of George Sarton's great *Introduction to the History of Science* (Baltimore, 1927—1947), hereinafter referred to as Sarton, *History of Science*, Aldo Mieli, *La Science Arabe* (Leiden, 1938) and *Panorama General de Historia de la Ciencia II, La Epoca Medieval: Mundo Islamico y Occidente Cristiano*, Madrid—Buenos Aires, 1946.

[2] Mas'ūdī, *Tanbih*, ed. Cairo. 1357/1938, 208.

It certainly seems to have been the case that medicine was known to the pre-Islamic Arabs. We hear of al-Ḥārith b. Kaladah, a skilled player on the lute as well as a doctor, who died about the year 13/634. He had studied at the medical school of Jundishāpūr, in what was then Persian territory, and practised medicine during the lifetime of Muḥammad in the Yemen[1]. Other early doctors of the same period or a little later were Ibn abī Rimthah at-Tamīmī[2] and 'Abd al-Malik b. Abjar (Abḥar) al-Kinānī.[3] The first medical work to be written in Arabic was a paraphrase (*tafsīr*) made from a compendium of medicine by an Alexandrian, Aaron the Priest (Ahrūn al-Qass), of whom little is known. From the title (*Kunnāsh*) it appears that this compendium was either originally written in Syriac, or more probably had been translated from Greek into Syriac before passing into Arabic, as happened to many Greek works subsequently. The honour of making the first Arabic translation is assigned to a certain Māsarjawaih, a Jew of al-Baṣrah. According to a story current long afterwards, the *Kunnāsh* was rendered into Arabic by Māsarjawaih during the Caliphate of Marwān (64/683—65/685), or somewhat later, and lay among the treasures of the Umayyads till the days of the pious Caliph 'Umar b. 'Abd al-'Azīz (99/717—101/720). His attention having been directed to it in some way, 'Umar ordered it to be brought out and placed in his oratory (*muṣallā*). 'Then for forty successive mornings, we are told, he prayed for guidance as to whether or not to make it public. Finally he was convinced that the innovation would be to the advantage of the Muslims. The book was published, and the people were encouraged to study it. The story may be found in Ibn Juljul's *Ṭabaqāt al-aṭibbā' wal-ḥukamā'*[4] recently published in an excellent edition by Fu'ād Sayyid. ' It is also recorded in Ibn abī Uṣaibi'ah,[5] who got it from Ibn Juljul.

[1] Ibn Juljul, *Ṭabaqāt al-aṭibbā' wa'l-ḥukamā'*, ed. Fu'ād Sayyid (Cairo, 1955), 54 and n.

[2] Ibn Juljul, *op. cit.*, 57-58. The vocalisation of 'Rimthah' is from *Qamūs al-muḥīt*.

[3] Ibn Juljul, 59—60. Some accounts of Ibn Abjar appear to place him considerably later, in the time of 'Umar b. 'Abd al-'Azīz. See Fu'ād Sayyid's discussion *ibid.*

[4] Ibn Juljul, 61.

[5] Ed. A. Muller, I, 163.

About the same time, i.e. under the first Marwānids, alchemy makes its appearance in Islam. There is a familiar and pleasant story concerning the Umayyad prince Khālid b. Yazīd, who is said to have made great progress in alchemy under the guidance of a Christian monk, variously named Marianus by Ibn Khallikān[1] and Stephanus in the *Fihrist*.[2] Connected with Marianus is the Latin form Morienus, but the Arabic appears to be the original. This story has been doubted at various times, by Ibn Khaldūn[3] and much more recently by the historian of science Julius Ruska,[4] I think needlessly. Rather we may, I believe, reckon with the possibility that the translation of the *Kunnāsh* already mentioned was connected in some way with the intellectual interests of Khālid b. Yazīd, the *ḥakīm* or wise man of the Marwānids[5] as he was sometimes called. Contrary to expectation, Khālid b. Yazīd did not succeed to the Caliphate. It is quite possible that it was he who, at some time or other, received the medical translation from Māsarjawaih.

That alchemy was at least known to the Arabs, if not actually practised by them, as early as this (i.e. not later than about 80/700) seems borne out by a remarkable story in the *Kitāb al-imāmāh wa's-siyāsah*, ascribed to Ibn Qutaibah[6] in the 9th century A.D., but perhaps rather by some contemporary of Ibn Qutaibah. According to this account,[7] the Caliph 'Abd al-Malik appointed his brother Bishr b. Marwān as governor of al-Baṣrah, with Musā b. Nuṣair, the future conqueror of Spain, as his principal adviser. Bishr was fond of pleasure and handed over the whole conduct of affairs to Mūsā. While

[1] *Wafayāt al-a'yān*, ed. Cairo, A. H. 1310, I, 168; transl. MacGuckin de Slane, I, 482.

[2] Ed. Cairo, 1348 A. H., 340.

[3] *Muqaddimah*, ed. Bulaq-Beirut, 505 transl. F. Rosenthal (London, 1958), III, 229-30, Cf. adh-Dhahabī, *Ta'rīkh al-Islām* (Cairo, 1367 A.H.), III, 247.

[4] J. Ruska, *Arabische Alchemisten, I, Chalid ibn Jazid ibn Mu'awija* (Heidelberg, 1924).

[5] *Fihrist*, ed. Cairo, 338.

[6] Brockelmann, *Geschichte der arabischen Litteratur*, I, 122; *Supplement*, I 187.

[7] *Kitāb al-imāmah wa's-siyāsah* ed. Cairo, no date, with the title *Ta'rīkh al-khulafā' ar-rāshidin wa-daulah banī Umayyah*, II, 55.

thus withdrawn from business, he was visited by a man of Iraq who offered him a potion, claimed to be a specific against old age, i.e. apparently the *elixir vitae*, after drinking which he was to refrain from all exertion during a period of forty nights. Bishr accepted and drank the potion, but when a short time later news came to him that he had been given al-Kūfah as well as al-Baṣrah by his brother, he could not be restrained from mounting and riding in the direction of his new governorship. According to the story, after proceeding a few miles he chanced to place his hand upon his beard, which fell away in his hand. Greatly alarmed, he returned to al-Baṣrah, where he died shortly afterwards. In the *Kitāb al-ma'ārif*, an uncontested work of Ibn Qutaibah, it is said that he died of drinking the remedy called *idhrīṭūs*[1]. The death of Bishr b. Marwān was in 75/694.[2] His immediate successor in Iraq was the redoubted al-Ḥajjāj.

Though the date is thus fixed, the facts of this surprising story are evidently not clear. It may, however, serve to carry back the beginnings of alchemy among the Arabs to the time of Khālid b. Yazīd, for he and Bishr b. Marwān were of course contemporaries.

About the same time astrology and astrologers begin to be mentioned among the Arabs. Astrologers were, as is well known, a regular feature of life at court and elsewhere under the Abbāsids. It comes as something of a surprise to meet them already in Umayyad times. The famous Dutch Orientalist De Goeje pointed out more than one reference to astrology in the Caliphate of 'Abd al-Malik, who during his momentous campaign in Iraq against the forces of the anti-Caliph 'Abd Allāh b. az-Zubair was accompanied by an astrologer to whom he was much attached[3] (71/690). Twenty-four years later, in 95/713, al-Ḥajjāj on his death-bed is reported as conversing with an astrologer[4]. Again as in the case of medicine and of alchemy, which we have already considered, the beginnings of astrology in Islam appear to be connected with outside influences. Much earlier than

1 Ed. Wustenfeld, 180.

2 According to adh-Dhahabī, *Ta'rīkh al-Islām*, III, 142, he died in this year, apparently of blood-poisoning.

3 *Memoire sur les Carmathes du Bahrain et les Fatimides*, 120-21.

4 *'Uyūn wa'l-ḥadā'iq*, ed. Anspach (Leiden, 1853), 16.

this, in Classical antiquity, the Chaldaeans and Magians had enjoyed high reputation as astrologers, the source or repository of their science being ancient Babylonia. Now on the same ground the influence of the older science appears to have made itself felt.[1]

Other influences besides the Babylonian affected the development of astrology. The term 'astrolabe' for the most generally used of astrological instruments is obviously Greek. The name of one of the earliest exponents of astrology under the Umayyads—Taufīl ar-Rūmī—is as evidently Greek. Ibn Khaldūn informs us that this Taufīl of Theophilus, usually called Theophilus of Edessa, predicted that the rule of Islam would last for the period of a great conjunction, i.e. 960 years.[2] The expression introduces us to a line of thought which was originally no part of the astrology of the Greeks, as found, for example, in the *Tetrabiblos* (*Quadripartitus*) of Ptolemy. The general idea of the theory of conjunctions, which of course makes the ordinary astrological assumption that phenomena in the heavens have an effect on, or rather are determined by the same set of causes as, events on earth, is that the apparent meeting of two planets in a given part of the zodiac, corresponds to some highly important earthly happening. Since the movement of the heavenly bodies can be calculated, these conjunctions can be estimated beforehand and the future foreseen. To be more precise,[3] the zodiac, or apparent track of the sun, with its twelve constellations, is divided into four triads (Arabic *muthallathah*). A lesser conjunction of the so-called upper planets, Saturn and Jupiter, which alone are considered for this purpose, occurs once every 20 years. It is then reproduced at intervals of 20 years, in the same triad but in different signs or constellations, twelve times, according to the rule that in passing from one sign to another the conjunction passes to what is called the trine aspect dexter (Arabic *tathlīth aiman*), i.e. the two planets are always separated by a third of the zodiac, counting in the direction opposite to the order of the signs. After 20×12 years

[1] Possibly also in the apparent instance of alchemy in Iraq mentioned above.

[2] *Muqaddimah*, 337; transl. F. Rosenthal, II, 216.

[3] See the account given by Ibn Khaldūn, *Muqaddimah*, 335 ff., with the explanations of de Slane, *Notices et Extraits*, T. XX, *Les Prolegomenes d'Ibn Khaldoun, Deuxieme Partie*, 217 ff; transl. F. Rosenthal, II, 211 ff.

the conjunction passes into the next triad, and there repeats the process in another 240 years, and so in the third and fourth triads. At the end of 960 years the planets forming the conjunction are back once more in their original positions, and this is a great conjunction. The period of 240 years is a middle conjunction. The theory (which was undoubtedly much older than Theophilus of Edessa) is thought to go back to the Indians. It was the subject of a study in early 'Abbāsid times by the great al-Kindī,[1] who evidently accepted it implicitly.

If the theory of conjunctions is rightly ascribed to the Indians, we clearly have another element to be taken into account in considering the rise of astrology among the Arabs. There is indeed precise information about the Indian contribution in another connection. We know that a set of Indian astronomical tables was brought to Iraq in the Caliphate of al-Manṣūr and translated into Arabic by Ibrahīm b. Ḥabīb al-Fazārī,[2] who was also the first man in Islam to construct an astrolabe[3]. These tables were called in Arabic *Sindhind*, from Sanskrit *Siddhanta*. They were used, as Ibn al-Qifṭī tells us[4], by several Muslim scholars, notably Ḥabash b. 'Abd Allāh al-Baghdādī,

[1] *Risālah fi mulk al-'Arab wa-kamiyatihā*, text, and translation by O. Loth, 'Al-Kindī als Astrolog' in *Morgenlandische Forschungen*: *Festschrift Herrn Professor Dr. H. L. Fleischer* (Leipzig, 1875), 261—309. Ibn Khaldūn, who mentions that the Shi'ah called this work of al-Kindī *al-Jafr*, from its similarity of subject to a book of their own of the same name, supposes it lost, and conjectures that it may have been among the books thrown into the Tigris by Hūlāgū at the fall of Baghdad (*Muqaddimah*, 338; transl. F. Rosenthal, II, 219). But it still exists.

[2] Ibn al-Qifṭī, *Ta'rīkh al-ḥukamā'*, ed. Lippert (Leipzig, 1903), 270. Cf. Mas'ūdī, *Murūj*, VIII, 291. Ibn al-Qifṭī and others make the translator of the *Sindhind* Muḥammad b. Ibrāhīm al-Fazārī, a different person from Ibrahīm b. Ḥabīb al-Fazārī, to whom Ibn al-Qifṭī gives a separate article (*Ta'rikh al-ḥukamā'*, 57). But this is a mistake, due to confusion, also in Yāqūt (*Udabā'*, VI, 268), of Ibrāhīm b. Ḥabīb al-Fazārī the astronomer, with his son Muḥammad b. Ibrāhīm al-Fazārī, mentioned in the *Fihrist* (ed. Cairo, 118) as a grammarian. The Ibrāhīm b. Muḥammad al-Fazārī mentioned (*Kitāb al-ma'ārif*, ed. Wustenfeld, 257) as a traditionist belonged to a different family. The error was scarcely avoided by Mieli (*La Epoca Medieval*, 48) who has Muḥammad b. Ibrāhīm in his text as translator of the *Sindkind* but Ibrāhīm b. Ḥabīb in the index.

[3] *Fihrist*, ed. Cairo, 381; Ibn al-Qifṭī, 57.

[4] Ed. Lippert, 266.

Muḥammad b. Mūsā al-Khwārizmī and al-Ḥusain b. Muḥammad known as Ibn al-Ādamī. These men, with Ibrāhīm b. Ḥabīb al-Fazārī, were very important for the development of astronomy in the strict sense among the Arabic-speaking peoples. Muḥammad b. Mūsā al-Khwārizmī, whose name will meet us again, was commissioned by al-Ma'mūn before he became Caliph to make an abridgement of al-Fazārī's translation[1]. Ḥabash b. 'Abd Allāh, as we learn from al-Mas'ūdī, made no fewer than three new sets of tables on the basis of the *Sindhind*[2]. He is perhaps better known by the name Aḥmad b. 'Abd Allāh, al-Ḥāsib al-Marwazī[3]. With this group Arabic astronomy as distinct from astrology may be said to have started.

At the same time as the *Sindhind* or later there were introduced from India two other systems of calculation, which apparently were less well known than the other, viz., the so-called *madhhab al-Arjabahad* and *madhhab al-Arkand.* Al-Mas'ūdī[4], who as well as Ibn al-Qifṭī[5] mentions these, says that the first was a compendium (a thousandth part, he calls it) of the *Sindhind,* while the *Arkand* is in turn from the *Arjabahad.* The latter name is undoubtedly for Aryabhata, an Indian mathematician of about 500 A.D.[6], and *Arkand,* in Latin later, when the translations from Arabic came to be made, *Arcandam,* from *Khanda-Khadyaka,* the work of Brahmagupta, circa 628 A.D [7].

The name of the Indian *savant* who brought the *Siddhanta* to the Arabs is given by the *Fihrist*[8] and Ibn al-Qifṭī[9] as Kankah or Kabkah. Among other works he is credited with a *Kitāb an-namūdār* (Book of the Proof, or Example) where *namūdār* is 'an astronomical device for verifying the exact date of a birth' (Steingass), as requisite in judicial astrology. *Namūdār* falls into line with other words of similar origin,

1 Ibn al-Qifṭī, 270-271.

2 *Tanbīh,* ed. Cairo, 187. Cf., Ibn al-Qifṭi, 170.

3 Ibn al-Qifṭī, *ibid.*

4 *Mūruj,* I, 150. (*Sindhind* and *Arjabahad* only). In the *Tanbīh* (ed. Cairo, 188) Mas'ūdī speaks briefly of all three. The text there less well has "*Arjabahaz*'.

5 Ed. Lippert, 266 ('*Arjabahar*').

6 Mieli, *La Epoca Medieval,* 24, cf. 49.

7 Nafīs Aḥmad, *Muslim Contribution to Geography* (Lahore, 1947), 73, citing Datta and Singh, *History of Hindu Mathematics,* Part I, 83.

8 Ed. Cairo, 378.

9 Ed. Lippert, 265.

such as *Arcandam* already mentioned, *alcochoden* or *colcodea* for *kadkhudā*, *hylech* for *hailāj*, *naxatra* (i.e, the lunar mansions) and many more, which were destined to prove completely baffling to European scholars at the Renaissance and were partly responsible for the undeserved discredit into which the mediaeval Latin versions from the Arabic then fell.

Some other Indian scientists who influenced the development of Arabic mathematics and astronomy, etc., are mentioned in the *Fihrist.*[1] A mysterious Ṭimṭim or Ṭumṭum al-Hindī is repeatedly cropping up in various sources,[2] without, I believe, much light having been thrown on him. In general, we may say that at the beginning of the scientific movement in Islam, as we can see from various indications, the direct contributions of Persia and India were very important, the former mirrored, for example, in some of the technical terms of astrology which have been mentioned. Later on the influence of Greek thought established itself. Solid work of translation from the various languages was done. In the opinion of Albumasar (Abū Ma'shar al-Balkhī) the four greatest translators in Islam were Ḥunaīn b. Isḥāq, al-Kindī, Thābit b. Qurrah and the less well-known but certainly meritorious 'Umar b. Farrūkhān. This is an interesting expression of opinion,[3] but it has to be remembered that of these certainly al-Kindī was not a translator in our sense of the term, but rather an interpreter of hitherto only half-understood foreign works.

It is perhaps worth mentioning here that in the department where the Indian influence on scientific thought in Islam was strongest, viz., mathematics and the sciences immediately depending on it, some of the impetus must have been received by the Indians themselves from the Greeks, for the *Siddhanta* appears to bear unmistakable traces of Greek influence and even Greek origin.[4]

Perhaps it may seem that in this sketch of the development too much stress has been laid on foreign influences and pseudo-scientific

[1] Ed. Cairo, 378.

[2] E. g., Ibn Khaldūn, *Muqaddimah*, 497; transl. F. Rosenthal, III, 156.

[3] Cited by al-Qāḍī Ṣā'id, *Ṭabaqāt al-umam*, ed. Cheikho (Beirut, 1912), 37, *Livre des Categories des Nations*, transl. R. Blachere (Paris, 1935), 81, and repeated by Ibn abī Uṣaibi'ah, I, 207.

[4] Mieli, *op. cit.*, 18 ff.

elements. It is difficult to project oneself back into the atmosphere of the second century of Islam, the 8th Christian century, when the scientific movement in Arabic began to make progress. Yet it will readily be granted, as to foreign influences upon the culture, that the Arabs when they emerged from the deserts of Arabia, as far as science is concerned, had nearly everything still to learn. They naturally made use of the knowledge accumulated by men of other races. Further, while the masters of the new Islamic state were absorbing knowledge, in the early stages, from almost every quarter, the lack of a criterion of thought, except in matters purely religious where of course the *Qur'ān* easily held its ground, must have been felt as a great defect and evidently led at times to great confusion, we might almost say chaos, of mind. It is plain that even for the contemporaries of al-Manṣūr and al-Ma'mūn, in intellectual matters, the boundaries between the real and the imaginary, the actual and the possible, were difficult to draw. Caliphs spent time interrogating claimants to the prophecy[1]; visions and portents, happy or ghastly, were seen and believed[2]; the greatest scientific genius of the age, the rightly celebrated al-Kindī, wrote an elaborate treatise to prove by astrology, using the theory of conjunctions already discussed, that the duration of the rule of the Arabs would be precisely 693 years[3], and he confirmed this result by reckoning the numerical value of the initial letters at the head of certain *sūrahs* of the *Qur'ān* (the well-known *fawātiḥ*, Aliph Lām Mīm, etc.)[4]. Rational knowledge, if that is what we mean by science, had to make headway against prevailing ignorance and superstition, and did make progress, but it is not surprising that it was itself affected adversely, especially at the beginning, and affords evidence, in the persons even of its devotees, of unreason.

The original city of Baghdad, founded by al-Manṣūr on the west bank of the Tigris in 145/762, seems to reflect the spirit of that age.

[1] Al-Ma'mūn (Mas'ūdī, *Murūj*, VII, 36) and another instance (*ibid.*, 52-53); al-Mutawakkil (*ibid.*, 383).

[2] Mas'ūdī, *Murūj*, IV, 266 (the Jew Baṭrūnī evokes phantoms in the mosque at al-Kūfah for al-Wa id b. 'Uqbah); *ibid.*, VI, 157-158 (vision of the mother of al-Manṣūr); *ibid.*, VIII, 181—182 (apparitions seen by al-Mu'taḍid); *Fihrist.* (ed. Cairo, 339) (al-Ma'mūn sees Aristotle in a dream).

[3] 'Al-Kindi als Astrolog' (cf. p. 6, n. 1), 275, 297.

[4] *Op. cit.*, 275-276, 297-299.

The fact that it could be constructed at all indicates that the engineering skills of past ages had, to say the least, not been lost. Yet the conception of a fortress-capital, perfectly circular in form, of great size (more than five miles in circumference[1]) and surrounded by a triple wall, is astonishing, almost fantastic. Whose this idea was is not, it seems, stated. Two astrologers prominent at the foundation of Baghdad Naubakht[2], a Persian, and Māshā'llāh, a Jew, are mentioned[3]. Perhaps it was due directly to al-Mansūr himself, and certainly it had his approval. The same applies to the interior arrangements. At the centre was the Caliphal Palace of the Green Dome (al-Qubbah al-Khaḍrā') with the Mosque of al-Manṣūr, surrounded at regular intervals by various public buildings, the treasury, armoury, etc. From the centre, which still offered ample open space, radiated four wide main streets, piercing the triple wall and giving access in all directions. Such an architectural creation had scarcely been seen in the world before. The highly artificial and elaborate plan on a smaller scale was reproduced, as we are told by Ṭabarī,[4] at ar-Rāfiqah, opposite ar-Raqqah, on the Euphrates. Baghdad came into existence in this arresting form from nothing in four years (145/762—149/766). One detail at least seems certainly due to al-Manṣūr himself, since it is difficult to think that anyone would have ventured to suggest it to him—what is described as the statue of a horseman bearing a spear in his hand, which stood 120 feet high on the summit of the Green Dome and could be seen all over Baghdad. The dome and statue survived till 329/940, when on a day of heavy rain and wind, the dome fell, bringing with it the statue.[5] It was apparently never rebuilt. It was said that the armed horseman had the remarkable property of turning round and facing the direction from which an attack on the capital threatened. The legend is mentioned by Ibn al-Khaṭīb in his *Ta'rīkh Baghdād* (History of Baghdad), and Yāqūt contradicts him, saying that this is

[1] Cf. Le Strange, *Baghdad during the 'Abbasid Caliphate* (Oxford, 1924), 18&n.

[2] Cf. Mas'ūdi, *Murūj*, VIII, 290.; Qazwīnī, *Āthār al-bilād*, 209, and next note.

[3] Both Naubakht and Māshā'llāh are said by Ya'qūbī to have selected the time for laying the foundation of Baghdad (*Kitāb al-buldān*, B.G.A. VII, 238).

[4] Ed. Leiden, III, 373.

[5] Yāqūt, *Mu'jam al-buldān*, I, 684.

'but a cheat and a manifest lie', and that 'the religion of Islam is not glorified by such fables'.[1] Perhaps the figure set up by al-Manṣūr had the ordinary advantage of acting as a weather-vane, but its original purpose was doubtless to serve as a talisman. We have it on the nearly contemporary authority of Albumasar mentioned above (Abū Ma'shar al-Balkhī, born circa 172/788) that a pupil of the *savant* 'Ubaid Allāh b. as-Sarī constructed beetle talismans (*ṭilsam al-khanāfis*) for many of the houses of Baghdad[2]. These were undoubtedly something like Egyptian scarabs, and probably copied from them. Evidently talismans were fashionable in Baghdad at an early date.

It need not surprise us, as has already been indicated, that men of this age and later were often more interested in alchemy than chemistry, and more concerned with horoscopes and conjunctions than with what we now regard as the legitimate operations of astronomy. Rather it is remarkable that in a number of departments they made positive and solid advances, which have been recognised as such by successors.

It can scarcely be doubted that one of the departments where the Islamic contribution has been greatest is mathematics. This perhaps is generally admitted, if we take mathematics and astronomy together. The map of the heavens today bears the most open and obvious traces of the preponderance at one time of Arabic astronomy. Star-names like Algol, Aldebaran, Rigel, Altair, Betelgeuse and Vega[3] are simply Arabic words left untranslated in Latin and still in use in the most modern astronomy. They have been so used in Europe for nearly 1000 years. The Latinized names of astronomers who wrote in Arabic like Albategnius, Alchabitius, Alfraganus,[4] etc., in common use till the Renaissance and later, likewise point to the same Arabic influence.

Apart from astronomy, the Arabic contribution to mathematics has been extraordinarily rich. This immediately comes to light in

[1] Cf. Le Strange, *op. cit.*, 31n.

[2] Abū Ma'shar al-Balkhī, *Mudhakarāt* (Cambridge University MS. Gg. 3, 19, cf. E.G. Browne, *Handlist*, 200), fol. 2b.

[3] These and a great many other star-names derived from Arabic were discussed by L. Ideler, *Untersuchungen uber den Ursprung und die Bedeutung der Sternnamen* (Berlin, 1809).

[4] See below in the main part of the book for these and other similar names.

what we call the Arabic numerals, the decimal system 1—9 with the zero or cipher. Both of these last expressions are simply Arabic *ṣifr*, 'empty', the sign used for the equivalent of 0. This system has been a great boon to calculators wherever it has been received, which means practically everywhere. It was certainly incomparably more convenient for most purposes than the older Roman system which it replaced in Europe. Coming originally from India, it may be assumed to have reached the Arabs about the same time as the first of the Indian tables already mentioned, i.e. in early 'Abbāsid times. The date of introduction into Europe is more doubtful. Probably, as Mieli says, the so-called *ghubārī* numerals (*ḥurūf al-ghubār*, i.e. 1—9 without the cipher were known to Gerbert, the 10th century scholar, whose abilities raised him to the Papal chair[1]. But the system as a whole was scarcely in common use until after the publication in 1202 A.D. of the *Liber Abaci* of Leonardo Fibonacci, a treatise on the various operations of arithmetic using the Arabic numerals, with the principles of elementary algebra. At least from this time the Roman system was gradually replaced[2]. It may here be mentioned that another system of notation which became very popular in the Middle Ages and later, viz., the signs used to represent the planets in works of astrology, does not seem to be deduced from the Arabic, and perhaps never occurs in Arabic MSS. These planetary symbols are explained as the initial letters of the corresponding names in Greek[3].

Turning now to algebra, which has an Arabic name and according to the celebrated Renaissance scholar Cardanus was an invention of the Arabs, we find that while this opinion turns out to be wrong, the contribution of Arabic-writing mathematicians is most impressive. The first and best known work on algebra was written by the same Muḥammad b. Mūsā al-Khwārizmī as was given the task of correcting the *Sindhind* by al-Ma'mūn[4]. Al-Khwārizmī's book bears some trace of Indian influence and carries the algebraic processes

[1] *Op. cit.*, 193.

[2] Mieli, *op. cit.*, 262 and n.

[3] By J. Beckmann, *A History of Inventions and Discoveries*, transl. by W. Johnston, ed. 3 (London, 1817), III, 59ff.

[4] See above.

no further than equations of the first and second degree. Hence the impression which long prevailed that the Arabs never had anything more elaborate and advanced than second degree equations. Al-Khwārizmī's book is entitled *Kitāb al-jabr wa'l-muqābalah*,[1] where *al-jabr*, from which of course the word algebra comes, literally 'restoration', or perhaps simply 'joining', is the process of transposing negative quantities to the opposite side of the equation with change of sign to positive, while *muqābalah*, literally 'confrontation' is the process of comparing positive and negative terms in a compound quantity and the reduction subsequent to such comparison (Rosen). Thus given $bx+2q=x^2+bx-q$.

by *al-jabr* $bx+2q+q=x^2+bx$.

and by *al-muqābalah* $3q=x^2$.

Al-Khwārizmī also wrote an arithmetic which was translated into Latin[2]. Algorism, or algorithm, the word used regularly in the Middle Ages for arithmetic with Arabic numerals, is simply a rendering of al-Khwārizmī in Latin (Algorismus, etc.)[3].

The Persian *savant* 'Umar Khaiyām (11th century A.D.), writing in Arabic, had solutions of equations of the third and even fourth degree. This was demonstrated by the historian of science Francois Woepcke[4] who later published the *Fakhrī* of al-Karajī or al-Karkhī, a work on algebra dedicated to a Buwaihid vizier called Fakhr al-Mulk evidently in the last years of the 10th century A.D., which shows the great lengths to which' in the interval between al-Karajī and al-Khwārizmī algebra had been taken among the Arabs. On the basis of the *Fakhrī* Woepcke reached a number of important conclusions[5]:

1. The Arabs knew indeterminate algebra.
2. Their works on this subject were based on the work of the Greek Diophantus.
3. They added to the algebra of Diophantus, both by inventing new procedures and also by proposing problems of higher degrees.

[1] Ed. F. Rosen (London, 1831).

[2] Cf. Mieli, *op. cit.*, 57.

[3] Carra de Vaux, 'Astronomy and Mathematics' in *The Legacy of Islam* (Oxford, 1931), 381, 386.

[4] In his book *l'Algebre d'Omar Alkhayyami* (Paris, 1851).

[5] F. Woepcke, *Extrait du Fakhri* (Paris, 1853), 3.

4. The Arabs used a different method of indeterminate analysis from the Indians, and consequently were in this matter independent of the Indians.

5. The works of Leonardo Fibonacci are to a great extent borrowed from the Arabs and particularly from al-Karajī.

With the possible exception of Hero of Alexandria, Diophantus is the only Greek writer who dealt with algebra. His date is usually given as *circa* 250—275 A.D. Diophantus was translated in the 10th century A.D. by Abū'l-Wafā' al-Būzajānī, another important Arabic-writing mathematician[1]. It is easily seen where al-Karajī received the impulse for his algebraical researches. It was undoubtedly Diophantus who started him off. But it is not so easy to see where 60 or so problems in al-Karajī, and not in Diophantus, come from. The most obvious explanation is that he invented them. Some of these additional problems require for their solution equations of as high as the 9th degree[2]. Quite clearly it was a rich vein which Leonardo Fibonacci and others like him opened up for the benefit of European scholars, and Mieli is surely right in characterising al-Karajī as one of the most distinguished of Arabic mathematicians[3].

In another department of mathematics, viz., trigonometry, the Arabic mathematicians made great progress. Here also they were initially indebted to the Indians, who first developed the ideas of sine and cosine, and the use of these trigonometrical functions[4]. It is scarcely possible to speak of trigonometry among the Greeks, for even Ptolemy was unacquainted with the sine. The Indian work which became known to the Arabs as the *Sindhind*, as we saw, gave the latter their first notions on these matters, which they were quick to extend. Ḥabash *alias* Aḥmad b. 'Abd Allāh al-Ḥāsib al-Marwazī[5] discovered what he called the *ẓill*, i.e. in the Latin translations the *umbra*, or *umbra recta extensa* (horizontal shadow), in effect the cotangent, and the *ẓill ma'kūs*, i.e. the *umbra versa*, in effect the tangent[6] He

[1] Carra de Vaux, *op. cit.*, 390.

[2] Woepcke, *Extrait du Fakhri*, 5.

[3] *Op. cit.*, 104-105.

[4] Mieli, *op. cit.*, 23.

[5] See above.

[6] Mieli, *op. cit.*, 60.

also knew the cosecant and probably the secant, though this is often said to have been discovered by Copernicus[1]. These functions were studied by al-Battānī (Albategnius). At approximately the time of the fall of Baghdad in 656/1258 we have Naṣīr ad-Dīn Ṭūsī's masterpiece on trigonometry, the *Kitāb ash-shakl al-qaṭṭā'* (Book of the Sector)[2]. This probably represents the highest achievement of trigonometry in Islam.

So we might pursue the subject. We have left aside without a mention the impressive development of Arabic medicine, which for a time during the Middle Ages dominated the medical practice of Europe[3], and in certain directions, especially in regard to some of the ancillary branches such as *materia medica* and botany, went beyond the researches of antiquity. We have had nothing to say of Arabic geography; of the measurement of a degree of the earth's surface by order of al-Ma'mūn[4], a difficult operation which was certainly not undertaken without a serious scientific purpose; of the compass[5], adopted by the Arabs from the Chinese, and then taken over by the Italians; of the specific weight of elements, calculated by al-Bīrūnī[6], to mention no others; of the 'universal instrument' invented by Jābir b. Aflāḥ[7]; of the *Optics* of Ibn al-Haitham (Alhazen), with ar-Rāzī (Rhazes), al-Bīrūnī and Ibn Sīnā (Avicenna) among the greatest exponents of Arabic science[8]; nor of the hospitals and observatories erected in Muslim countries during the Middle Ages. But enough has been said perhaps to indicate the quality and extent of the legacy which Arabic science was in a position to pass on to the West, when the time came for its reception. The main part of the book attempts to show how this actually happened.

1 Carra de Vaux, *op. cit.*, 390n.

2 Cf. Carra de Vaux, 396; Mieli (*op. cit.*, 171) has in error *saki* for *ash-shakl*.

3 Recent studies on the subject include Amin A. Khairallah, *Outline of Arabic Contributions to Medicine and the Allied Sciences* (Beirut, 1946), and D. M. Dunlop, 'Arabic Medicine in England', *Journal of the History of Medicine and Allied Sciences*, XI (1956), 166-182.

4 Mas'ūdi, *Murūj*, I, 182-183.

5 J. Hell, *The Arab Civilization*, transl. S. Khuda Buksh (Cambridge, about 1925), 88.

6 Mieli, *op. cit.*, 91-92.

7 Mieli, *ibid.*, 143-145.

8 Mieli, *ibid.*, 100-103.

ARABIC SCIENCE IN THE WEST

I The Beginnings of the Transmission

However one approaches the question of the transmission of Arabic science to mediaeval Europe, whether as scientist or historian, one is faced at the outset, in some form or another, by a rather disconcerting paradox or even contradiction. This involves, on the one hand, the Arabs as barbarous invaders of the civilised world and, on the other, the Arabs as teachers of the barbarous West. For both of these positions there is a good deal to be said. The Arabists at all times, becoming more vocal perhaps since Casiri's great catalogue enabled the world at large to glimpse the extent and variety of the collection of Arabic manuscripts in the Escorial, have stressed the importance of the Muslim contribution to civilisation. Some writers in their enthusiasm have expressed views which would be difficult to substantiate, like the Spanish Jesuit Andres in the eighteenth century, who went so far as to declare that the re-establishment of sound learning in Europe, after the collapse of Graeco-Roman civilisation, was due to Arabic literature. 'While the Christian schools were engaged in teaching church singing, reading and simple arithmetic,' wrote Andres, 'the Arabs sent embassies to seek out good Latin and Greek books, erected observatories to study astronomy, made journeys to gain information on natural history and founded schools to teach all the sciences'[1]. This is no doubt true, but the conclusion which Andres sought to draw hardly follows.

On the other hand, it is not so long ago since the Belgian economic historian Pirenne produced his brilliantly-argued generalisation as to the real cause of the break-down of the Roman system, and by voice as well as pen urged the view that the end of classical antiquity and the beginning of the Middle Ages came not as a result of the Germanic invasions, but owing to the disruption of Mediterranean unity by the rapid and unexpected advance of Islam.[2] More recently the Oxford historian R. G. Collingwood

[1] Cited by A. Gonzalez Palencia, *Historia de la Literatura arabigo-espanola*, ed. 2 (1945), 310.

[2] *Muhammad and Charlemagne* (English transl., 1939), 284.

in his *New Leviathan* (1942), disregarding the Northern invaders who were, he says, 'in no sense inspired by hatred of Rome or the civilisation for which Rome stood', characterised Islam as 'the first barbarism', i.e., the first attack by barbarians on the civilised, Christian world.[1]

The terms on both sides of our paradox can in fact be contrasted too sharply, but the paradox remains. An attempt must be made to resolve it before the Arabic contribution to Western science can be seen clearly in its setting. We shall therefore have to concentrate first on the How? of Arabic scientific influence on the West rather than the What?, i.e., restrict our consideration to the mechanics of the transmission and leave till later the content of what was actually transmitted.

It is plain that the Arabs, before they could transmit science, had first to acquire it. This part of the process has in general terms long been understood, and it is not necessary to say a great deal about it. The Arabs emerged from their peninsula in the seventh century A.D. with little culture of their own, apart from a highly developed art of poetry. Science among them, even in its less authentic aspects—the astrology, alchemy and magic which in the Middle Ages came to be thought of as in a special sense Arabian, though really older—, was rudimentary or unknown. But they were apt to learn, and in the civilised provinces of the Greek and Persian empires into which they came—notably Syria, Egypt and Iraq—accommodated themselves to a more settled way of life, and began to be interested in the pursuits of the conquered peoples. Thus we hear of Khālid b. Yazīd, an Umayyad prince in Damascus, who died in A.D. 704 or a little later[2] and is reputed to have been the first alchemist in Islam.

Arabic became the universal language throughout the Muslim empire. It was spoken by men of all races, and gradually replaced for literary as well as practical purposes the languages formerly in use, Greek, Syriac, Persian and Coptic. Contacts were made with regions practically beyond the horizon of the Greeks—Turkestan,

1 *Op. cit.*, 352.

2 Adh-Dhahabī, *Tar'ikh al-Islām*, III, 247.

India and China. A new civilisation, basically Muslim, but formed from many elements, was rising. Already in Umayyad times (up to A.D. 750) but especially after 800 under the auspices of the 'Abbāsid Caliphs, translations into Arabic from Greek, Syriac and other languages were made, chiefly of the scientific and philosophical works which had earlier been the staple of instruction at the school of Alexandria. Many of these translations, as well as original works in Arabic, were in turn translated at different times and places into Latin, so that when the process was complete, not before the close of the thirteenth century,[1] the scholars of western Europe had at their disposal a large number of what are usually called 'Arabist' texts of various kinds. These brought a very considerable extension of knowledge over a wide field (philosophy, theology, mathematics, natural science and medicine) and maintained their popularity until they were slowly superseded by translations from the original Greek and the new works characteristic of the Renaissance. Our concern is with the later part of the process. The main point or points at which contact was made with the Latin West, the dates involved, the protagonists of the movement of translation into Latin and the general course of Arabist infiltration are matters as yet insufficiently known and not in themselves entirely clear. It is these which will form the principal topics of discussion in the following pages.

To describe the situation of the Western vis-a-vis the Islamic world at the period during which the infiltration of ideas and techniques from the latter to the former began to take place is a task which cannot be attempted here. It may serve our purpose equally well to point to some recorded instances of contact between the two systems. These, it can safely be said, are surprisingly few.

When Islam and Christendom first find themselves juxtaposed in the West, after the initial Muslim conquests, it is roughly speaking along the line of the Pyrenees. The invasion of Spain, begun in A.D. 711 and carried out by mixed forces of Berbers and Arabs, was conspicuously successful, and in a few years their advanced

1 Cf. C.H. Haskins, *Studies in the History of Mediaeval Science* (Cambridge, Mass., 1927), 19.

detachments had crossed into what is now France.[1] In the central Mediterranean Arab conquest, as distinct from mere raiding, proceeded much more slowly.[2] As far as our subject is concerned, Sicily and the south of Italy remained for the most part of secondary importance. The Arabs in the West encountered the inhabitants of Gothic Spain and the Franks earlier. The fiercest conflicts, and later the most fruitful contacts, were with them rather than the Italians.

At first the situation on the frontier is obscure, with the Arabs advancing into the Gothic province of Septimania, north-east of the Pyrenees, occupying Narbonne and fanning out east and west into Frankish territory, while the Franks resist and retreat, and await the opportunity of a counter-blow. The battle of Tours came in A.D. 732—fought on an October day by Charles Martel and his Franks in wolf-skins against the half-fabulous Abderame ('Abd ar-Raḥmān al-Ghāfiqī). The importance of the battle has been minimised in recent discussions, but it is at all events indicative of the turn of the tide of Arab invasion. In A.D. 759 Narbonne was recaptured by Pepin, the son of Charles Martel. Now that the immediate threat was removed by subsequent Arab withdrawal south of the Pyrenees, the absolute cleavage between the Franks and the Muslim world may be said to have ceased to exist.[3]

We begin to hear of embassies between Muslims and Christians of the West, which paved the way to better understanding, and perhaps in some cases led directly to the interchange of ideas, though scarcely as yet of books, of which the Arabs up to this time had but a limited supply. In A.D. 765 Pepin himself sent envoys not, it appears, to the recently-established Umayyad court at Cordova but to the East, where the great Manṣūr, real founder of the 'Abbāsid power, ruled as Caliph.[4] Some years before this, in 762, Manṣur had laid the foundation-stone of a new capital to replace Damascus – Baghdad, destined to become, for a time, perhaps the richest and

1 In A.D. 717 or 718 (Hitti, *History of the Arabs*, ed. 6, 1956, 499).

2 Cf. Hitti, *op. cit.*, 602.

3 G. Richard, *Annalen des frankischen Reiches* (Halle, 1885), II, 16, n.

4 Fredegartus's anno 768 (Migne, *Patrologia Latina, LXXI, col.* 696).

most civilised city in the world. It is attractive to think, though there is no real evidence of this, that the *demarche* of Pepin was connected with the political change in Spain, hitherto dependent on the Caliphs in the East but never again to be so. At all events, Arab envoys accompanied the returning Franks, when after three years they reached Marseilles, and were honourably entertained during the winter at Metz. We may wonder how the envoys from the south relished a winter spent in a mediaeval town or castle, and what they did with their time, but the source reveals nothing of this. In spring Pepin met them at Selles, on the Loire, and gifts were interchanged. Perhaps the possibility of concerted action against the Umayyad ruler in Spain was discussed, before they were escorted back to Marseilles to take ship for their own country.[1]

Under Charlemagne, as might be expected, there was diplomatic activity between the Arabs and the Franks. In 777 a Muslim *amīr* came in person to Paderborn in Westphalia with a proposal that the Franks should intervene in the affairs of Spain.[2] Next year Charlemagne's abortive expedition to Saragossa actually took place. The famous action of Roncesvaux, when the Frankish army was attacked while retreating through a pass in the Pyrenees, was a consequence. After this Charlemagne seems to have been in diplomatic contact with 'Abd ar-Raḥmān I of Cordova, perhaps offering him cessation of hostilities.[3] In 785 the inhabitants of Gerona voluntarily delivered their city to the Franks[4], and in 801 Barcelona was taken.[5] These last events were of much importance for the future. Barcelona was never recovered by the Arabs and from 801 an outpost of the Frankish empire, it later became the capital of what was practically an independent state, the Spanish March, or Catalonia. The whole region was in Muslim hands for less than a century, at a time when the Arabs were still in no state to leave a civilising impression. The old culture in this region, on the

1 Fredegarius, *ibid.*

2 E. Levi-Provencal, *Histoire de l'Espagne musulmane*, I (1944), 87.

3 *Ibid.*, 85, 89 ff.

4 *Ibid.*, 91.

5 *Ibid.*, 125 ff.

other hand, appears to have suffered less than in many parts of Europe, being sheltered alike from the storms which brought the Carlovingian renaissance to an end and from the depressing influences which affected Latin culture, as such, in the rest of Spain.

Considerations of this kind properly belong to another part of our discussion. We have not yet completed the tale of early diplomatic contact. Charlemagne himself is said in the Western sources to have exchanged embassies with Baghdad. We are told that 'Aaron, king of Persia' i.e. the Caliph Hārūn ar-Rashīd, of *Arabian Nights* fame, sent rich gifts including fabrics, aromatics, a water-clock and an elephant to Charlemagne. At least the 'pipe-organ' sometimes mentioned among the presents from Baghdad seems to be fictitious. It is apparently based on a mistranslation of the word 'clepsydra' for the water-clock mentioned above.[1] There is nothing of all this in the Arabic sources, and evidently no practical results were forthcoming, beyond certain concessions made to Charlemagne by the Caliph in regard to places of Christian pilgrimage in Palestine. So much at least is stated by a reliable authority a little later.[2]

Visits were also paid to Charlemagne's court at Aix-la-Chapelle by an Umayyad pretender, and by a governor of Barcelona shortly before the fall of that city into Christian hands.[3] In the reign of Charles the Bald ambassadors from Cordova came to Rheims (A.D. 847), while in 863 yet another Muslim envoy was lodged for a European winter at Senlis and finally given audience at Compiegne in the following July. He returned accompanied by a French envoy, who reappeared at Compiegne in 865 with many gifts, fabrics, spices and, most exotic of all, camels with palanquins on their backs.[4]

An Arab contact with western Europe of a more unusual kind is recorded in the account of a journey made by sea from Spain to what is described as the court of the king of the Norsemen, apparently in A.D. 845. The narrative has been accepted as genuine

1 Hitti, *op. cit.*, 298. Cf. also H. G. Farmer, *The Organ of the Ancients* (London, 1931), 139-146.
2 Christian Druthmar, in Migne, *Patrologia Latina*, CVI, col. 1486.
3 Levi-Provencal, *op. cit.*, 126.
4 *Ibid.*, 148 n. 2, 199 and n. 3.

by most authorities and, although its connection with the history of science is somewhat tenuous, is so curious that it deserves mention here.[1] In the ninth century the coasts of Spain were no more exempt than other parts of Europe from the invasions of the Norsemen, as is clear from the Arabic historians. One such raid took place in A.D. 844, when fifty or sixty viking ships, repulsed on the Tagus by the Muslim inhabitants of Lisbon, sailed southward to Cadiz, and had succeeded in capturing Seville, before they were finally defeated in battle and driven off by troops from Cordova. The Umayyad 'Abd ar-Raḥmān II wanted to send someone to the court of the king of the Norsemen, apparently to protest about the raid. According to the contemporary account, his choice fell on Yaḥyā al-Ghazāl, a man of talent and a poet, who had already served on an embassy to Constantinople. Yaḥyā al-Ghazāl accordingly proceeded from Cordova to the coast at Silves, where a ship had been made ready and, accompanied by some returning Norsemen in another ship, set sail northwards.

Unfortunately the route and destination are alike obscure. Some critics have thought that the convoy skirted the coast of Spain and Portugal, crossed the bay of Biscay to the Channel and eventually reached the 'court of the King of the Norsemen' somewhere in Denmark, perhaps Jutland.[2] Others have taken the destination to be Ireland,[3] where the Norsemen at this time had settlements and to which the description in the narrative of 'a great island in the surrounding Ocean, with flowing waters and gardens, three days' sailing, or three hundred miles, from the mainland' is somewhat more appropriate, especially if a place on the west coast of Ireland is intended. It is noticeable that no names are mentioned after the ships had passed the mountainous promontory which

[1] See Pons Boigues, *Historiadores y Geografos Arabigo-Espanoles* (Madrid, 1898) 38-43; R. Dozy, *Recherches sur l' histoire et la litterature de l' Espagne pendant le moyen-age*, ed. 2, II, 269 ff.; Ḥussain Mones, 'Contribution a l'etude des invasions des Normands en Espagne musulmane entre 859 et 844 (sic) J.C., in *Bulletin de la Societe royale d' etudes historiques* (*Egypte*), II, i (1950), in Arabic. Levi-Provencal, *op. cit.*, 177-178, cf. the same, 'Un echange d' ambassades entre Cordoue et Byzance au ixe siecle,' *Byzantion, XII* (1937), 15-16, regards the narrative as unauthentic.

[2] So Ḥussain Mones, following Dozy.

[3] Notably Allen Mawer in *Cambridge Medieval History*, III, II, i, 317.

marks the western limit of Spain, called in the narrative Aluwiyah, perhaps Cape Finisterre. Ireland under its proper name appears to have been known to the western Arabs at least as early as the time of al-'Udhrī, who in his once-famous work on geography, written probably in 1058,[1] devoted a section to 'Irlandah'[2]. Certainly al-Idrīsī about a century later (*circa* 1154) deals with Ireland as well as England and Scotland.[3] Al-'Udhri explicitly mentions the Norsemen in 'Irlandah'[4] though it cannot be shown that he is dependent on the account of Yaḥyā al-Ghazāl. In general, records of mediaeval Arabs visiting the British Isles are almost non-existent[5]. A certain 'Abd ar-Raḥmān b Hārūn al-Maghribī claimed to have sailed the 'Western Sea' in A.D. 901 and to have reached al-Barṭūn (? Brittany), and later there is an unconfirmed mention of the Moors in Domesday, as sojourners or settlers in London.[6] We need say no more here of Yaḥyā al-Ghazāl's journey than that he is stated to have returned to Compostella, in the company of an embassy of the Norsemen to the Christian king of the Asturias, and to have stayed some time there, before passing by way of Castile and Toledo to Cordova, which he reached after an absence of twenty months. In all this of course it is not a question of transmission of scientific ideas. When Arabist influence appears in England in the eleventh century, it has come indirectly.[7]

Much the most detailed account which we have of such an embassy is to be found in the *Life of John of Gorz*,[8] a Lotharingian churchman who spent several years in Cordova in the 10th century (from 953). In this case the contact seems to have played an ascertainable part in the cultural process. It appears that about the

1 Qazwīnī, *Cosmography*, ed. Wustenfeld, ii, 373.

2 It has been suggested that 'Irlandah' here is for Izlandah, Iceland (G. Jacob, *Arabische Berichte von Gesandten an germanische Furstenhofe aus dem 9 und 10 Jahrhundert*, 1927, 26, n. 2).

3 Cf. D. M. Dunlop, 'Scotland according to al-Idrīsī', *Scottish Historical Review*, XXVI, no. 102 (1947), 114-118; A.F.L. Beeston, 'Idrīsī's Account of the British Isles,' *Bulletin of the School of Oriental and African Studies, University of London*, XIII, Part 2 (1950), 265-280.

4 Qazwīnī, *op. cit.*, II, 388-389.

5 Cf. D.M. Dunlop, 'The British Isles according to Mediaeval Arabic Authors,' *The Islamic Quarterly*, IV (1954) 11-28.

6 Lord Lytton in a note in chapter iv of *Harold*.

7 See *infra*.

8 In Migne, *Patrologia Latina*, CXXXVII.

year 950 the German emperor, Otto the Great, had opened up a correspondence with Cordova about the Spanish pirates who were infesting the Mediterranean sea-board. An Arab delegation came north, but before the business could be transacted, the head of the embassy, a Spanish bishop, fell ill and died. It was necessary to send a reply to Cordova. Two envoys were selected, one of whom at the last minute was unwilling to go. It is implied that there was difficulty in finding a substitute, and John of Gorz is highly commended for his willingness to take the other man's place. But if among the administrative class a mission to Muslim Spain was an ungrateful duty, there were others in the community whose business took them regularly to these distant parts. One such man, a certain Ermenhard of Verdun, was associated with the embassy as guide. The probable reason why this Verdun merchant was in the habit of visiting Spain will presently appear.

From Gorz the party followed the most direct route, i.e. southwards by Langres and Dijon to Lyons, thence by ship down the Rhone (losing their baggage in process) and round the east end of the Pyrenees to the Spanish March. From Barcelona, where they made a halt, word was sent on, announcing their arrival, to Tortosa, at this time the first important place held by the Arabs. Invited to cross the frontier, they waited for a month at Tortosa, till suitable arrangements could be made for their accommodation farther on. In due course they started again, making a circuit apparently ia Saragossa, and proceeded by easy stages to Cordova. Later on, when the mission threatened to be a failure, the same journey was performed in the opposite direction by an envoy from Cordova. Rabī‘ b. Zaid (Recemundo) in about 10 weeks.

We must limit ourselves to those aspects of the embassy which bear on the transmission of new ideas. John of Gorz was a scholar, and when on a mission to Italy earlier, he had brought back to his monastery manuscripts of Aristotle and Porphyry. He can scarcely have failed to be impressed by one of the first persons whom he met at Cordova, the accomplished Jewish physician Ḥasdai b. Shapruṭ. Hasdai[1] occupied a trusted position at the court of ‘Abd ar-

[1] The Latin text (col. 301) has 'Hasdeu'.

Rahmān III and represented in person some of the new trends which were then being followed in Spain. He is here found fulfilling the function of dealing with distinguished strangers, which he claims for himself in his celebrated Letter to the king of the Khazars. How far his acquaintance with John of Gorz proceeded we are not told, but he was certainly a man from whom much could have been learned. Another contact of the envoy from Lorraine was a Spanish prelate, also called John, with whom he conversed familiarly on various matters, including the position of the Christians in Muslim Spain. Altogether John of Gorz was in Spain for three years, during which time, as already mentioned, recourse had to be had again to the German authorities. It is unlikely that a man of this type would not bestow some of his too great leisure on the milieu in which he found himself, especially when potential instructors were evidently to his hand.

The envoy to Germany, Recemundo, or Rabī' b. Zaid, to call him by his Arabic name, meanwhile visited Otto in Frankfurt, and returned to Cordova in due course accompanied by another native of Verdun, a certain Dudo, with new instructions. Though a layman, he was elevated to the episcopal see of Elvira, as a reward for his services. While at the German court Rabī' b. Zaid had met a Lombard churchman, Liutprand, and had persuaded him to write his historical work entitled *Antapodosis*, which was dedicated to the Spaniard. The work has survived, and we can there read that a trade in slaves existed between the Christian West and Muslim Spain. In particular, Liutprand mentions the enormous profit which this brought to the merchants of Verdun[1]. We hear about the traffic elsewhere, for example in Maqqarī[2], and no doubt it was a question of heathen captives from the East and the North taken in the wars of the German kings. What is of special interest is that Liutprand evidently got his information about the business of the Verdun merchants while at Frankfurt. It is not a very remote inference that Ermenhard and Dudo, the Verdun merchants who served on these embassies because of their familiarity with Spain, were themselves engaged in the slave-trade.

1 Cited Levi-Provençal, *ibid.*, 364, n. 2. 2 *Nafḥ aṭ-ṭīb*, ed. of Leiden. I, 92.

That the mission of John of Gorz had echoes in literary circles in Germany seems certain. The writings of the Saxon nun Hrosvitha, at this time a member of the religious community of Gandersheim, have survived. Her description of the brilliance of contemporary Cordova, in a Latin poem on the life and death of the Mozarab Pelagius (died A.D. 925), is well known :

Corduba famosa locuples de nomine dicta,
inclyta deliciis, rebus quoque splendida cunctis,
maxime septenis sophiae repleta fluentis,
necnon perpetuis semper praeclara triumphis[1].

Hrosvitha mentions also the Spanish ruler of the time:

Abdrahemen dictus, regni splendore superbus[2].

How had she learned about these matters? Hardly by direct personal knowledge, as has sometimes been said, for though there is evidence for the presence of foreign monks at Cordova as early as the ninth century,[3] it is scarcely thinkable that women from Germany ventured on the long and dangerous journey. Hrosvitha seems in fact to have lived and died at Gandersheim. But through her superior there, a Saxon princess, niece of Otto I, she appears to have been in touch with the court at Frankfurt. It is at least a likely conjecture that she got her information about Spain from the same quarter, after the return of John of Gorz.

Apart from Hrosvitha, there are indications of typically Arabist culture in Lorraine shortly after this time, especially in the field of mathematics. According to the late James Westfall Thompson,[4] 'While we lack positive evidence of the pursuit of Arabic science in the schools of Lorraine in the years immediately following John of Gorz's return from Spain, the constructive evidence points to it and inverse reasoning affirms it'. 'I am convinced,' he writes, 'that the schools of Lorraine in the last half of the tenth century were the seed-plot in which the seeds of Arabic science first germinated in Latin

1 Migne, *Patrologia Latina*, CXXXVII, *Pelagius*, ll. 15 ff.

2 *Ibid.*, *Pelagius*, l. 75.

3 Levi-Provencal, *ibid.*, 167, n. 1.

4 In 'The Introduction of Arabic Science into Lorraine in the 10th Century', *Isis*, XII (1929), 184-193.

Europe, from which knowledge radiated to other parts of Germany, to France, and especially into England.' We shall be able to see the matter in a somewhat clearer light presently.

While these embassies are not the only instances of contact between Christendom and Islam at this early period, they are the most readily available for providing evidence of actual datable meetings between definite persons at definite places. The prominence which has been given to them here is due also to the fact that they tend to present the political background against which we must look for the transmission of ideas. Before leaving this part of the subject, we shall mention one more contact, apparently of the same kind.

There are a number of interesting geographical notices in Arabic, relating to places in Christian Europe long before the time of al-Idrīsī (*circa* A.D. 1154). These consist of extracts from the geographical work of al-'Udhrī, already mentioned,[1] the *Book of the Routes and Kingdoms of Spain.* They are at present found in the *Cosmography* of al-Qazwīnī (thirteenth century A.D.). Al-'Udhrī's work included a number of citations from a certain aṭ-Ṭurṭūshī, evidently a native of Tortosa in Spain, Notices in al-Qazwīni of Asti in north Italy, and of Fulda, Schleswig, Paderborn and other places in Germany appeared to be derived via, al-'Udhrī from this informant. The name, in full Ibrāhīm b. Aḥmad aṭ-Ṭurṭushī, has not apparently registered itself in any other literary source and is otherwise unknown. The suggestion is that al-'Udhrī originally got his information from him orally.

Another Spanish geographer, a younger contemporary of al-'Udhrī, al-Bakrī (1040—1094), has incorporated in his work a first-hand account of a journey through Eastern Europe of the Jewish slave-trader Ibrāhīm b. Ya'qūb,[1] made probably in A.D. 973. The accounts in al-'Udhrī's extracts and in al-Bakrī partially tally. It has been supposed that Ibrāhīm b. Aḥmad aṭ-Ṭurṭūshī and Ibrāhīm b. Ya'qūb were in contact in the lands of the Franks, and since the former mentions a commission to the Spanish Caliph with which he has been charged by some great Christian king, he is conjectured to have met Ibrāhīm b. Ya'qūb at the court of Otto I

[1] Most recent edition by T. Kowalski, *Monumenta Poloniae Historica, Nova series*, 1 (Cracow, 1946).

in 973.[1] An embassy of some kind is indicated, as it is unlikely that the Emperor would converse with casual foreigners in Frankfurt. In view of the dates (the *Book of the Routes and Kingdoms of Spain* was written apparently in 1058) al-'Udhrī will then have got his information from aṭ-Ṭurtushī as an old man. It seems simpler to take Ibrāḥīm b. Aḥmad aṭ-Ṭurtushī and Ibrāhīm b. Ya'qūb as the same person, whose information became available to both al-'Udhrī and al-Bakrī, in the latter case presumably not by word of mouth. Ibrāhīm b. Ya'qūb was a Spaniard, and it seems that his report may have been a confidential one, written for the Spanish Caliph rather than for publication. His generic name is not given in al-Bakrī and he might easily have been from the frontier town of Tortosa. On the other hand, the patronymic of Ibrāhīm b. Aḥmad aṭ-Ṭurṭūshī varies in different places.[2] It certainly looks as if the Spanish geographers depend on the account of a single man, and that his name was Ibrāhīm b. Ya'qūb of Tortosa.

However this may be, it is certain that the account of the lands of the Franks in al-'Udhrī and al-Bakrī represents a real advance of knowledge among the Spanish Arabs. Up to this time there were apparently no texts dealing with what lay north of the Pyrenees. Positive geographical data may have been available, but it is not reflected in Spanish-Arabic literature before the time of al-'Udhrī. We may see this from his contemporary Ibn 'Abd al-Barr (978-1071), reputed to be the best traditionist of his time in Spain, whose notions about the Franks remain rudimentary.[3] The interest in geography in eleventh century Spain seems to have been something new. Geography had begun to be cultivated in Baghdad and elsewhere in the East from the ninth century and by the tenth great advances had been made. The title of al-'Udhrī's book—*Routes and Kingdoms of Spain*—is not

[1] G. Jacob, *Ein arabischer Berichterstatter....aus dem* 10. *Jahrhundert*, ed. 3, Berlin, 1896. Jacob was the first scholar to draw attention to the citations from at-Ṭurṭūshī in al-Qazwīnī.

[2] Cf. Levi-Provencal in *ar-Rauḍ al-Mi'ṭār* (text, 171 Ibrāhīm ibn Yūsuf; translation, ibn Yaḥyā). Kowalski (*op. cit.*, 3, 29 ff.) mentions a MS. of al-Bakrī in Fez, where the name appears as Ibrāhīm b. Ya'qūb al-Isrā'īlī at-Ṭurṭūshī.

[3] Cf. D.M. Dunlop, 'An 11th Century Spanish Account of the Northern Nations', *Bulletin of the School of Oriental and African Studies*, XV, Part I (1953), 159-163.

fortuitous. It is an adaptation of the title of similar books of 'Routes and Kingdoms,' which had appeared in the East earlier. Spanish interest in geography in the eleventh century must probably be regarded as part of a wider intellectual movement which we have still to characterise.

But we must first say something about the knowledge of Arabic in western Europe up to the time which we have now reached. Spain and other territories occupied by the Muslims are in a special category. In Spain Arabic came into general use, even among Christians. At some time—it is not certainly known how early—the Spanish Church found it necessary to translate the Scriptures and other religious works from Latin into Arabic. The variety of such translations still existing in manuscripts is considerable. It is safe to say that in Spain Arabic became the principal language for most, if not all, cultural purposes for Muslim and Christian alike.

But a knowledge of Arabic elsewhere in Europe up to the eleventh century is far to seek. The embassies of which we have spoken must have made use of interpreters, and in several cases this is distinctly stated. The Umayyads of Spain in their contacts with Christian powers evidently employed their Christian subjects, especially ecclesiastics, whose higher education still included Latin. Rabī' b. Zaid (or Recemundo), already mentioned as going to the court of Otto I, is a case in point. There was no similar class of ready-made interpreters in Europe north of the Pyrenees. Yet we may readily think that in the little kingdoms of Christian Spain and in Catalonia Arabic speakers might be found and retained. Elsewhere in Europe there is no evidence of Arabic before the eleventh century—with the exception of a word or two correctly understood by Druthmar, a monk of the Westphalian monastery of Corvel about A. D. 850.[1] In the eleventh century, however, Constantine Africanus produced a notable series of translations from Arabic into Latin, principally medical works. About the same time an exchange of letters between an unnamed monk of France and al-Muqtadir b. Hūd, ruler of Saragossa (1046-1081) took place, apparently in Arabic, in which language the correspondence is preserved in the Escorial [2] (The great flowering of translation from the Arabic associated with

[1] Migne, *Patrologia Latina CVI*, col. 1347 'Syriace,' 1480 'Hebraice'.
[2] Cf. D.M. Dunlop, 'A Christian Mission to Muslim Spain in the 11th Century,' *Al-Andalus*, XVII (1952), Fasc. 2, 259-310.

such names as Gerard of Cremona, and Michael Scot comes much later and belongs to the twelfth and thirteenth centuries.)

The generally accepted view has been that translation from Arabic into Latin began with Constantine Africanus in the eleventh century, and that before this time, apart from the doubtful facts connected with Donnolo (*circa* 913-982) and the early career of Gerbert (*circa* 930-1003), there is no question of Arabic influence from any quarter on the scientific thought of the West. This is in effect the view of those distinguished historians of science Sarton and Mieli. The overall picture presented itself in such a way that the likeliest time for the general introduction of Arabist Latin texts into Europe has seemed to be the twelfth rather the eleventh century, much less the tenth. It is consonant with a twelfth century date for the appearance of Arabist productions in the intellectual centres of the Latin West that the celebrated Abelard (1079-1142) is apparently unaware of their existence. The writings of Abelard, whom we should suppose to be sensitive to new ideas from any quarter, and who has a *Dialogue between a Christian, a Jew and a Saracen*, seem to betray no hint of Arabism. This is in striking contrast with writers of the next century, Albertus Magnus, for example, whose pages are full of Arabist citations. The Toledan school indeed, of which the leading translators were at first Dominicus Gundisalvi and his master in Arabic, the converted Jew John Avendeath (Ibn Dā'ūd, Johannes Hispanus[1]), became active only about 1140, long after Toledo had passed into Christian hands (A.D. 1085). Some time later Gerard of Cremona came to Toledo (*circa* 1167) and began his very fruitful activity there, working with a Mozarab called Ghālib (Galippus). About the same time another Italian, Plato of Tivoli, was resident at Barcelona. Like the others he worked with a colleague who knew Arabic well, Abraham bar Hiyya (Abraham Judaeus or Savasorda, for *ṣāḥib ash-shurṭah*). Between them these two translated a number of important works on mathematics and astronomy.

But the translations must have begun earlier. In 1927 Professor Haskins of Harvard drew attention to a Latin manuscript of the

[1] For new views of him, and for the school generally, see D.M. Dunlop, 'The Work of Translation at Toledo', *Babel*, VI (1960), 55-59.

tenth century from the library of the monastery of Santa Maria of Ripoll[1] in Catalonia, which had been catalogued by Rudolph Beer in 1908. This MS. began with a short treatise on the astrolabe and contained a table of the stars with Arabic names, practically in the forms which are still used today (Altair, Vega, Rigel, Aldebaran Algol, etc.) Another tenth century MS. from the Biblioth que Nationale with the *Mathematica Alhandrei summi astrologi* had previously been examined by Lynn Thorndike[2] and was found to offer transcriptions of the Arabic names of the twenty-eight lunar mansions. Alhandreus, with variants Alchandrinus and Alchindrinus appeared to be a corruption of Alchindus, i.e. al-Kindī[3], the first of the great names in Arabic philosophy, who wrote on astronomy and astrology and died about 870 after a life spent in the East, near the seats of the 'Abbāsid Caliphs. Again there could be no doubt of Arabic influence, and Haskins concluded that in view of the existence of these tenth century manuscripts the questions involved required to be re-opened.

It was with these words of Haskins in mind that James Westfal Thompson wrote the article which has already been quoted, on the introduction of Arabic science into Lorraine in the tenth century.[4] Thompson, connecting the transmission with John of Gorz, as we saw, may have put it somewhat too early, and himself admitted that in the years immediately following the return of John of Gorz there is no positive evidence for Arabic science in Lorraine. His article was followed by another with the title 'Lotharingia as a center of Arabic and scientific influence in the eleventh century' by Mary Catherine Welborn[5]. These contributions pointed to another and earlier source of Arabist ideas than Constantine Africanus in the eleventh century, who, according to the received view, began the transmission, in the field of mathematics and astronomy, not of medicine. For in 1025 Radolph of Liege was in correspondence with his friend Ragimbold of Cologne, telling him

1 Haskins, *op. cit.*, 9, n. 20. The MS. in question is No. 225.

2 *History of Magic and Experimental Science*, I (New York, 1923), chapter 30.

3 J. M. Millas Vallicrosa, *Assaig d'historia de les idee, fisiques i matematiques a la Catalunya medieval* (Barcelona, 1931)—in Catalan—, 253.

4 See p. 26, n. 4

5 *Isis*, XVI (1931), 188—199.

that he has an astrolabe, apparently of Arabic type, while *circa* 1048 Hermann Contractus of Reichenau, evidently under the influence of Lotharingian teachers, wrote a work on the astrolabe, in which he mentions an instrument which he calls *atzalchora, id est planam spheram.*[1] This is for Arabic *wasṭ al-kurah*, 'middle part of the sphere,' and he must be talking of the planispheric astrolabe. Though the work of Hermann Contractus is not a translation from Arabic—but rather 'an attempt to make clear existing notions on the construction of the astrolabe,'[2]—it appears to be based on such a translation.

Further, in the same century, as Haskins had already pointed out,[3] another churchman from Lorraine, Walcher, who had settled in England, observed an eclipse on 18 October, 1092, with the help of an astrolabe. It will not surprise us that he uses technical Arabic expressions to describe the instrument, mentioning the indicator as *almeri* (i.e. active participle of the Arabic verb 'to show') and calling one of the points *almagrip* (i.e. the West). In time Walcher became a considerable astronomer, being helped in his studies by Petrus Alfonsi, otherwise Moses Sephardi, who was resident in England for a period as royal physician.[4] We again note the co-operation with a native Arabic speaker, apparently indispensable for a Latin Arabist at this time.

These facts evidently accord well with the existence of tenth century Arabist manuscripts, dealing with astronomical matters. A treatise or tractate in the tenth century Ripoll manuscript actually bears the title of the work of Hermann Contractus in the eleventh century (*De mensura astrolabii*). The suggestion is indeed, as J.W. Thompson had surmised, that there is some connection between Lorraine and Spain.

An outstanding contribution to the question which we have been discussing was made by J. M. Millas Vallicrosa in his *Assaig d'historia de les idees fisiques i matematiques a la Catalunya*

1 Quoted M.C. Welborn, *ibid.*, 194.

2 So H.P. Lattin, *Isis* XX (1933-1934), 579.

3 *Op. cit.*, 113—14.

4 See Millas Vallicrosa, *Nuevas Aportaciones para el estudio de la transmision de la ciencia a Europa a traves de Espana*, Real Academia de Buenas Letras, Barcelona, 1943, 26 ff.

medieval published in Catalan at Barcelona in 1931. Millas there surveys the sciences in Muslim Spain in the tenth century and indicates the source of the *essor* which they had recently taken, viz., the great activity of translation and assimilation in ninth century Baghdad. The intellectual movement in Spain was not confined to the capital but spread rapidly to other parts of the peninsula, according to Millas. It had not escaped the notice of previous writers that Catalonia was connected with Cordova as well as with Christian Europe. Reinaud a long time ago, pointed out that Godmar, bishop of Gerona, wrote a history of the kings of the Franks for al-Ḥakam, son and successor of 'Abd ar-Raḥmān III, in 939 apparently, when the Umayyad prince was a young man of about twenty-four. The work may originally have been written in Latin, and al-Mas'ūdī saw a copy of it, presumably in Arabic, in al-Fusṭāṭ (Egypt), eight years after its composition.[1] Various embassies between Catalonia and Cordova are recorded.

Millas claims that the revival of science in Muslim Spain reached Catalonia, basing his view not simply on general probability but also on the existence of the Ripoll manuscripts, one of which, as we saw, is definitely dated to the tenth century. He adduced also an authentic letter of Gerbert, written in May, 984, in which the request is directed to a certain Lupitus of Barcelona to send a translation which he has made of a work on astronomy (*librum de astrologia translatum a te.*)[2]. Such a translation can scarcely have been from any language but Arabic. Millas was not the first investigator whose attention had been attracted by this passage, but he saw it in a new context. Scientific activity in Muslim Spain, contact between Catalonia and Cordova, a tenth century translator of a work on astronomy, and one or more tenth century manuscripts of Arabic type in Catalonia —the connection was not fortuitous.

Millas gives much attention to the career of Gerbert. Though the romantic stories which grew up round this remarkable man affirmed that he had studied mathematics, judicial astrology, magic and what not in the schools of the Saracens at Cordova or Toledo, it seems unlikely that Gerbert's travels in Spain (between A.D. 967

1 Mas'ūdī, *Murūj adh-dahab*, III, 69 ff.
2 Gerbert, *Epistolae*, No. 24, addressed to Lupitus Barchinonensis.

and 970) took him farther than Catalonia. He does not appear to have known Arabic.[1] But he was certainly interested in astronomy and perhaps the first to introduce Arabic numerals into northern Europe.[2] Later he became master of the schools at Rheims, before his elevation to the Papal chair in 999 as Sylvester II. An Arabist, at all events a near-Arabist, teaching at Rheims, Arabism or something very like it in Lorraine a few years later—again there seems to be a causal connection.

Millas sought to show that the tenth century Ripoll MS.[3] contained material used by Hermann Contractus. The first tractate in the Ripoll MS. is a *De mensura astrolabii*, whose coincidence of title with the work of Hermann has already been noted above. Millas found that another tractate in the Ripoll MS., the *De utilitatibus astrolabii*, was apparently used by Hermann. We thus seem to have an activity of translation and adaptation in Catalonia and the schools of Lorraine, mediated by Gerbert.

It appeared to Millas that the two tractates just mentioned were respectively the first and second parts of a work on the astrolabe by the Jew Māshā'llāh, who flourished at the court of the 'Abbāsid Caliph Manṣūr, and he conjectured that the introduction of this work into Spain was connected with Ḥasdai b. Shaprūṭ,[4] already mentioned. The tractates were, he thought, adaptations of Māshā-llāh, based on a direct translation, also in part in the Ripoll manuscript. He even found it probable that this translation was the '*liber de astrologia*' translated by Lupitus of Barcelona,[5] and characterised the other texts as probably due to Lupitus.

It is not necessary to follow Millas in all the developments of his general position, and it is the case that neither in the work which we have been discussing nor in his later impressive study of Arabist works in Toledo *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo*, (Madrid, 1942) has he been able to adduce any other dated tenth century Arabist manuscript or to bring

1 Millas, *Assaig* etc., 106-109. 2 See p. 12. 3 I.e. No. 225. 4 *Ibid.*, 28. 5 *Ibid.*, 195.

more information about Lupitus of Barcelona. The importance of his work depends neither on details of interpretation nor even on the correct dating of these ancient manuscripts to the tenth century, which has not met with universal acceptance, though the palaeographers appear to have no doubts. It is rather that, basing on the solid facts where they are available, e.g. the date A.D. 984, when Gerbert asked for a translation of a book on astronomy, he has provided a frame-work into which all the evidence so far available can without much difficulty be made to fit.[1] One may venture to think that if and when more light is thrown on this earliest infiltration of Arabic science into Europe, it will be found not so very different from the picture which has already been sketched for us.

Since the work of Millas appeared, some evidence has accrued for another Arabist text, the so-called *Eisagoge* of Johannitius, generally regarded as one of the earliest of these productions. It is the version of an introduction to medicine by Ḥunain b Isḥāq, who died in the East A. D. 873. The Latin text is found in manuscript in the eleventh century[2] and already double-glossed in 1160.[3] The translator nowhere appears to be mentioned, and since the time of Steinschneider, the nineteenth century expert, it has been usual to suppose that he was Mark of Toledo. But from a recent full-scale study of Mark of Toledo it appears that he flourished later than had been thought,[4] and the known dates of his life (1191-1216) are too late for the version of which we are speaking. He did indeed translate the *Eisagoge*, but he was not the first to do so. Whoever the original translator may have been, the gap between his work and the tenth century manuscripts already referred to is not very great. Constantine Africanus, as we saw, translated medical works in the eleventh century, but the *Eisagoge* of Johannitius is not mentioned in

1 Lynn Thorndike (*Science and Civilisation*, ed. R.C. Stauffer, Madison, 1949, 52) with some justification criticises Millas for underestimating the level of science and learning in Christian Europe at the period of the transmission. But this of course does not affect the correctness of his view of the *modus*.

2 M. Inguanez, *Codicum Casinensium* MSS. *Catalogus*, III 28 (No. 225).

3 K. Sudhoff in *Archiv f. die Geschichte der Naturwissenschaft*, IX (1916), 354.

4 See M.T.d'Alverny and G. Vajda, 'Marc de Toledo', *Al-Andalus*, XVI (1951), 99-140, etc.

the earliest list of these.[1] In spite of this, it seems somewhat more likely that the translation of the *Eisagoge* is by Constantine than that we are to assume some anonymous eleventh century translator, or attempt to connect this particular translation with the activity in Catalonia earlier. Another early Arabist medical text, the *Aphorisms* of Mesue Senior (Yaḥyā b. Māsawaih) appears to be due to Constantine Africanus, though nowhere apparently mentioned among his works[2]. The same probably applies to the *Eisagoge* of Johannitius.

In the foregoing account of the transmission a great deal has been said about Spain and not much of Italy and Sicily as the *milieu* for the production of Arabist texts. The East of the Crusaders has not been mentioned. This is partly because we have been concerned with the beginnings, when the principal area of contact between western Christendom and Islam was Spain, partly also because of the relative importance of the contributions made. This can be shown in general terms as follows. Taking the tenth and eleventh centuries as the first period of the transmission, we have certain texts of astronomy and, if indications from the surviving Ripoll manuscripts are to be relied on, probably also works on mensuration and mathematics. The source of these is Spain. In the eleventh century the first Arabist medical texts appear. The great name is Constantine Africanus, who closes the early period. The source is south Italy. The middle period (twelfth century) produces the first philosophical texts, translated by Gundisalvi *circa* 1150. This period is characterised by extensive production of all kinds of Arabist texts (mathematical, astronomical, medical, alchemical, etc. as well as philosophical). The great names are Gundisalvi and Gerard of Cremona. The source in this middle period is principally Spain, to which come the Italians, Gerard of Cremona and Plato of Tivoli. The final period (thirteenth century and later) is characterised by continuous production in all departments, until most of what seemed of value had been rendered into Latin. The best-known name is that of Michael Scot, working

1 M. Steinschneider, 'Constantinus und seine arabischen Quellen,' *Virchow's Archiv*, Vol. XXXVII (1866), 352-354.

2 Cf. D. M. Dunlop 'John Mesue,' *Bulletin of the British Society for the History of Science*, I (1952), 213.

at Toledo and elsewhere. The main sources are Spain and Sicily. During the middle period the East of the Crusaders affords the names of Adelard of Bath and Stephen of Pisa, but the work done is quite overshadowed by what was produced nearer home.

II Michael Scot, Arabist

The transmission of Arabic science to the West was made possible, most obviously and immediately, by the translators from Arabic into Latin. It seems desirable to consider the work of one of these men more particularly, to see in what it consisted and how it was done. The name of Michael Scot is familiar to all, and the bearer of it seems specially suitable for such consideration. He flourished in the early thirteenth century, i.e. at the close of the middle period of translation from the Arabic, which was also the main period, and the beginning of the third and last. He is thus typical of the movement at its height. Also his activity was not limited to any one place, but included Italy and Sicily as well as Spain. But further the Arabist movement in the Middle Ages, in the nature of the case, has something exotic about it, which is not to be disregarded. This exotic character Michael Scot seems to have represented in person, or perhaps one should say that he represented the new movement on its more exotic side.

It is, I think, fair to say that there was a certain excitement in the minds of the Latins when first confronted with the new knowledge. Michael Scot seems personally to have felt this and may have been able to communicate it to others. He appears, however, in the sources not as a great teacher but as a somewhat anomalous figure, at once or in turn philosopher, astrologer and magician—in any case, a student of outlandish knowledge and a practitioner of unusual arts. To say less than this would be to do injustice to the reality behind the legend, which has remained extraordinarily vivid down the centuries.

The picture, as is natural, has varied considerably from time to time. At present, the impression which we have of Michael Scot is in the main due to his namesake and fellow-countryman, Sir Walter Scott, who makes him a Borderer, accepts some of the most romantic

stories about him (not out of place certainly in the *Lay of the Last Minstrel*) and for the purposes of his poem assumes that the 'wizard' and his 'mighty book' were buried in Melrose Abbey.[1] It is not necessary to go into great detail. The notes appended by Sir Walter to the *Lay of the Last Minstrel* contain references to Michael Scot in the works of Dempster[2] and others, and are a useful repository of the tales then current, or which had been current, in the Borders about him. It was by the contrivance of 'Auld Michael' that the Eildon Hills had been cleft in three and the Devil set to make ropes out of sand at Tweedmouth. He had passed through the air to France on a great black horse, at whose stamping the bells rang in every steeple in Paris. Sir Walter also refers to the more factual tradition that Michael Scot had formerly lived at Oakwood on the Ettrick, a few miles above Selkirk, and a propos of Michael Scot's studies in Spain mentions the singular belief that the sciences of magic were formerly taught at Toledo, Seville and Salamanca—especially at the latter place, where instruction in the black arts was given in a deep cavern, eventually walled up by order of Queen Isabella. (The fantastic tale contains of course authentic elements: Arabic science in Spain, and the existence of a famous university at Salamanca after the Reconquest.)

The French writer Naude offers a different view. In a work which appeared in 1553, on the great men who have been falsely accused of magic, he gives an account of Michael Scot and observes that he was not an idiot or ignoramus, as some people who have never read any of his books have thought.[3] This last opinion reflects the attitude of the Renaissance to mediaeval writings in general, and was no doubt confirmed by the circulation of spurious works of a fantastic character ascribed to Michael Scot. Of the authentic works Naude remarks, rather surprisingly, that only two survive, the *Physionomia* and the *Questions on the Sphere of Sacrobosco*. The title of a Latin book or pamphlet 'Michael Scot unjustly condemned for poisoning'. published in 1739,

1 For 'Michael Scot's lamp' see Sir W. Scott's *Monastery*, Introductory Epistle.

2 Thomas Dempster (d. 1625), author of the *Historia Ecclesiastica Gentis Scotorum*.

3 G. Naude, *Apologie pour tous les grans personnages qui ont este faussement soupconnez de magie* (La Haye, 1653), 497-499.

represents another apparently baseless view.[1] In more recent times Ernest Renan,[2] himself in conflict with his church saw in Michael Scot the first of a series of unorthodox thinkers who concealed their scepticism under the name of Averroes (Ibn Rushd), with whose introduction into Europe Scot was, as we shall see, closely concerned. It seems clear at all events that the personality of whom such divergent accounts could be given must have been a highly exceptional man.

To disentangle the facts of Michael Scot's life from the legend is not easy. A persistent tradition which connects him with the family of Balwearie in Fife seems to be based on a confusion. The antiquary Leland, who for a point of this kind is no doubt to be relied upon, says that he had it on good authority that Michael Scot was born in the country of Durham, and first went to school there.[4] Other evidence, as we shall see, connects him with the north of England, and there is a wonder-tale according to which he was employed by the town of Morpeth, desiring to rival Newcastle as a seaport, to bring the tide up to it by magical means.[5] A Durham connection is not necessarily inconsistent with his Scottish nationality, which is well attested by foreign sources. Towards the middle of the twelfth century, when his birth must have occurred, there are likely to have been families of Scottish origin in the northern counties of England, where shortly before this time the writ of the king of the Scots had run. Even as late as 1283 Tynedale and Penrith are mentioned as territories belonging to Scotland,[6] and the Righ Cross on Stainmore, at the boundary of Westmorland and Yorkshire, marks a more ancient division between the two kingdoms.[7]

But if we assume with Leland that Michael Scot was born in Durham, the next stages of his career are quite obscure. He is

1 Schmutzer, *De Michaele Scoto veneficii injuste damnato* (Leipzig, 1739) referred to by J. Wood Brown, *Life and Leg end of Michael Scot* (Edinburgh, 1897), x.

2 E. Renan, *Averroes et l' averroisme*, (Paris, 1893), 210.

3 See below, p. 46

4 Leland, *Commentarii de Scriptoribus Britannicis* (Oxford. 1709), I, 254.

5 H. L. Honeyman, *Northumberland* (London, 1949), 177.

6 Lord Hailes, *Annals of Scotland* (Edinburgh, 1819), I, 222.

7 J. Fordun, *Scotichronicon*, III, c. ii, cf. George 'Buchanan. *History of Scotland* (Edinburgh, 1715), 116 D.

said to have studied at Oxford and Paris, and later at Padua, but all this appears to be mere supposition. The seventeenth century history of the University of Paris[1] says indeed that while there he applied himself diligently to mathematics, being called Michael Mathematicus,[2] and at length was made doctor of theology. But this is unsupported by any records. There is still less, it seems, for Oxford, while as to Padua, the fame which that city came to enjoy as a school of magic, as we shall see, was perhaps felt to be good and sufficient reason (there appears to be no other)[3] for making him a student there. The first certain date in Michael Scot's career is in fact 18 August, 1217, when we find him at Toledo, having just completed a translation from Arabic into Latin of Alpetragius (al-Biṭrūjī) *On the Sphere*.[4] How he reached Spain, and how he learned enough Arabic to engage upon the translation of a difficult technical work must remain matters of conjecture, but the reason for his being in Spain seems clear enough. Reports and results of the works of earlier translators must already have reached wide circles in the West. Whatever the immediate occasion of his visit, it is altogether likely the Michael Scot was in Spain in order to satisfy his curiosity about Arabic science.

From this time, as far as the dates of his life are concerned, we are on firmer ground. Michael Scot can be traced at Bologna, engaged apparently in medical practice, three years later (21 October, 1220).[5] Between 1224 and 1227, as the Papal registers show, he was in high favour at Rome. Pope Honorius III recommended him to Stephen Langton, then archbishop of Canterbury, as a man of eminent learning and worthy of a benefice in the

[1] Du Boulay, *Historia Universitatis Parisiensis*, III, 701, citing Balaeus, *Scriptorum Illustrium Majoris Britanniae Catalogus* (Basle, 1557).

[2] Hugh Scot, afterwards abbot of a Carmelite house at Ayr, 'applied himself to the mathematics under the famous Michael Scot,' where is not said—according to George Mackenzie, M.D., *Lives of the Scottish Writers* (Edinburgh, 1708), I, p. 425, quoting Dempster (cf. 39, n. 2). The date given by Mackenzie for Hugh Scot—*flor.* 1341—must in any case be too late, see below.

[3] A number of references to Michael Scot in Italian literature from Dante onwards, have been left out of account here. For them see e.g. J. Wood Brown, *op. cit.*

[4] C.H. Haskins, *Studies in the History of Mediaeval Science* (Harvard 1927), 273, cf. J. M. Millas Vallicrosa, *Las traducciones orientales en los MSS. de la Biblioteca Catedral de Toledo* (Madrid, 1942), 201. See now Francis J. Carmody, *Al-Bitruji*: *De Motibus Celorum*, a critical edition of the Latin translation of Michael Scot, University of California Press, 1952.

[5] Haskins, *op. cit.*, 274.

English province (16 January, 1224). On 18 March of the same year he obtained permission to hold two benefices, one of which seems to have been in England. A little later he was offered but declined the archbishopric of Cashel in reland. The ground given for the refusal was his ignorance of Irish. In 1225 he was permitted to hold an additional benefice in England and two in Scotland, while in 1227 his claims were again urged on the English archbishop by the successor of Honorius, Pope Gregory IX.[1] It is not wonderful to find Michael Scot in orders in the Church, and from these notices it appears that he was by this time a man of considerable seniority and standing. In 1227 or 1228 Leonardo Fibonacci, often regarded as the greatest mathematician of that age, dedicated to Michael Scot the second edition of his work *On the Abacus*, in which Arabic numerals as well as the principles of elementary algebra were definitively introduced the West.[2]. Perhaps about the same time Scot became a member of court of the Emperor Frederick II, with whom he continued to be associated[3] till his death, eight or nine years later (before 1236).

It is convenient to speak of the Spanish and Sicilian, or rather Italian, periods of the life of Michael Scot, but, as the sketch just given indicates, we have dates only for the last twenty years, and the length of the Spanish period is quite uncertain. It seems necessary to admit further that at some time, when already established as a professional scholar, he resided at home long enough to impress his legend on his own people. We have already said something of the stories which clustered round his name in the Scottish Borders. The wonder-tales about Michael Scot in Cumberland and Westmorland are not less numerous. Certain rocks on the summit of Carrock Fell were reared by him, and Orton Bridge in Westmorland was erected by magical means in a single night. A ledge of gravel running nearly across Ullswater is his handiwork, as is the underground stream at

1 The facts are given by Haskins, *op. cit.*, 274-275.

2 Haskins, *op. cit.*, 275; Aldo Mieli, *op. cit.*, 262, n. 3.

3 Haskins, *ibid.*

Stenkrith, near Kirkby Stephen[1] Bolton Old Church was built by imps at his command.[2] Even the seasonal 'Helm wind' which afflicts or cheers the citizens of Carlisle at the present day was an invention of Michael Scot.[3] Surely these tales,[4] however absurd, demand the presence of the 'wizard' at some time in this quarter.

A seventeenth century diary, under the date 22 August, 1654, speaks of Wolsty Castle, five miles west of Holm Cultram in Cumberland, then lying in ruins, and mentions one of the rooms as 'Michael Scot's chamber.'[5] This is not an isolated reference, for Camden earlier in his *Britannia*, first published in 1586, records that he was told, during his visit to Cumberland, that in. Wolsty Castle the works of Michael Scot lay mouldering in the dust.[6] Sir Walter Scott gives a similar story.[7] As Sir Walter noted, Holm Cultram is one of several reputed burial-places of Michael Scot. At present there is no information to be gained at Holm Cultram, which, like Melrose and Glenluce, the other claimants for the honour, was at one time a Cistercian house. Unfortunately we have no means of knowing the names of the benefices in England and Scotland to which Michael Scot was appointed in 1224 and 1225,[8] but the conjecture may be advanced that one of these was near Holm Cultram and others perhaps at Melrose and Glenluce. If we admit that the stories already given imply Michael Scot's residence on the Borders and in the north of England, no time seems more suitable on general grounds than the late twenties or early thirties of the thirteenth century. It appears that we can make the matter somewhat more precise. Apart from the doubtful testimony of Hector Boece, according to which Scot

1 Details from an article on Michael Scot by W.T.M. (MacIntyre). *Cumberland News*, 22 November, 1930.

2 W.G. Collingwood, *The Lake Counties*, London, 1949, 109.

3 From the article referred to in n. 1.

4 Charles Kirkpatrick Sharpe (*History of Witchcraft in Scotland*, London and Glasgow, 1884, 27) mentions that the road through the Lochar Moss, Dumfriesshire. is said to have been completed in one night by Michael Scott with the aid of the Devil.

5 Francis Grainger, 'James Jackson's Diary, 1650-1683', *Transactions of the Cumberland and Westmorland Antiquarian and Archaeological Society*, xxi, New Series (1921), 104.

6 *Britannia*, ed. Phil. Holland, 773.

7 *Loc. cit.*

8 Pressutti, *Regesta Honorii Papae III*, no. 5470, simply states the fact.

enjoyed the favour of an English king,[1] a much better authority, Roger Bacon, seems to say that he came to England some time after 1230. For Bacon reports, somewhat cryptically indeed, that Michael Scot 'appeared' after 1230 with parts of Aristotle and commentaries thereon hitherto unknown.[2] It cannot be asserted positively that Scot was in England at the time indicated. But he had certainly made his scientific debut long before 1230, and the words most naturally mean that he came within the view of Roger Bacon, then a young student, at that date. A visit to England, even a visit to Oxford, where Roger Bacon probably was at the time, seems indicated. The evidence is not conclusive, but we may assume provisionally that Michael Scot was back in this country for some time after 1230.

It is usually said that he spent the last years of his life in the service of the Emperor Frederick II and in his entourage, in Sicily or Italy, perhaps also in Germany. The direct evidence for this is slight. There is the dedication to Frederick of certain of his works, which need not be later in any case than 1228 or 1229.[3] Apart from this we appear to have nothing beyond a note in one manuscript, accompanying a series of Latin verses predicting the fate of the Lombard cities, the famous *Vaticinium*, to the effect that Michael Scot was at Bologna in 1231, and, being consulted by the *podesta* and others on this subject, gave the *Vaticinium* in reply, together with a similar note in another manuscript, which says that he recited the verses to the Emperor in Germany in 1235 or 1236.[4] These statements are perhaps not formally contradictory, but cannot be taken as certain. There are other statements, exceedingly unlikely or strictly impossible, that Scot was in Cordova before

1 *History of Scotland* (Paris, 1574), fol. 292 (Lib. XIII, *ad finem*): 'Michael Scotus, in medicina inter primos eruditus atque ob singularem peritiam non minus Eduardo regi Angliae quam Alexandro dum viveret charus acceptusque.' But Edward I of England reigned 1272-1307, and was born after Michael Scot's death.

2 'A tempore Michaelis Scoti qui annis Domini 1230 transactis apparuit deferens librorum Aristotelis partes aliquas de Naturalibus et Metaphysicis cum expositionibus authenticis, magnificata est philosophia Aristotelis apud Latinos,' (*Opus Maius*, ed. Bridges, III 66, cf. I 55, which is somewhat different). The passage is thus given by Renan (*op. cit.*, 205, n. 2) '......librorum Aristotelis partes aliquas de naturalibus et *mathematicis cum expositoribus sapientibus*, etc. i.e. the reading of the edition of S. Jebb (London, 1733), 36.

3 See below. 4 Haskins, *op. cit.*, 276 and nn.

the Reconquest (1236) and in Prague in 1255, at which latter date he must have been dead for many years.[1] The evidence for the date of his death is an authentic poem by a certain Henry of Avranches, addressed to Frederick in 1236,[2] in which Michael Scot is praised as a successful astrologer :

qui fuit astrorum scrutator, qui fuit augur,
qui fuit ariolus, et qui fuit alter Apollo.

Henry of Avranches says that he remembers hearing Scot making certain predictions about the Emperor, which he proceeds to give. It is quite plain from the whole tone of the poem that Michael Scot was no longer at the Emperor's court, that he had not been at court for some time, and the poet gives us the reason for this—at the time of writing Michael Scot was now dead.

His services to the Emperor Frederick, as astrologer and man of science generally, seem indeed to have been rendered earlier than is usually supposed. In the poem of 1236 Scot's death is not spoken of as a recent event. We probably have to go back several years for his last contact with the Emperor. It is natural to think that in 1228, at the time of the dedication to him of the book *On the Abacus*,[3] Michael Scot was still in Italy. He was presumably in Italy when what was apparently his own last book for Frederick, perhaps his last of all,[4] a composite work on astrology to be mentioned later, was completed—hardly before 1229.[5] Thereafter, it seems, we are look for Michael Scot in his own country rather than in Italy or Germany. His death evidently took place at an advanced age—for Vincent of Beauvais, writing about 1245, agrees with the legends of the Scottish Borders in speaking of 'old Michael Scot [6]—before 1236. The claims which have been made that his grave is at Melrose, Holm Cultram or Glenluce remain alike without confirmation, yet it is noteworthy that no foreign place is ever mentioned in connection with his death or burial.

We can at least be certain that the frequently repeated story which brings Scot back to this country, to die as a very old man in

[1] Cf. Lynn Thorndike, *History of Magic and Experimental Science*, II, 310, n. 3; Wood Brown, *op. cit.*, 18-19, 190-191.

[2] *Forschungen zur deutschen Geschichte*, XVIII, 485 ff.

[3] See above. [4] Cf., however, below. [5] Cf. Haskins, 280.

[6] Wood Brown, 176.

1290 or 1291, is based on a confusion. Quite apart from the credible statement that he was dead before 1236, this is strictly inconsistent with the date 1217 for his translation of Alpetragius, and is no doubt due to identifying him with the Michael Scot of Balwearie who is said to have gone as ambassador to Norway in 1290.[1] The same or more probably another Michael Scot fell at the battle of Neville's Cross in 1346.[2] Obviously there can be no question here of the philosopher. Yet this has been freely asserted, and in later times there was even a ballad about the 'wizard' and his cantrips at the castle of Balwearie.[3]

So much for the life and legend of Michael Scot. We now come to consider his authentic works, original or translated from the Arabic. Broadly speaking, the translations belong to Scot's Spanish period, when his interests were mainly philosophical, while his original works belong to the later Italian phase, in which he was mainly concerned with astrology.[4]

The translation of Alpetragius *On the Sphere* is dated 18 August, 1217 at Toledo, as already mentioned. This is not necessarily the earliest of Scot's translations, but we have nothing definitely earlier. The work has never been printed, but manuscripts are not very uncommon. It has been analysed by Munk,[5] and more recently by Duhem.[6] Michael Scot has here chosen for translation an Arabic author, Nūr ad-Dīn abū Isḥāq al-Biṭrūjī,[7] who was almost his contemporary. The *nisbah* or generic name al-Biṭrūjī gives rise to Alpetragius in Latin, as well as the more or less divergent forms Alpetrongi, Alpetrondji, Avenalpetrardi. All these indicate a connection with a place in the vicinity of Cordova called Pedroche. The date of composition of the original work is not

[1] Buchanan (132E) calls the ambassador 'Michael Scotus eques Fifanus illustris.' This is presumably from J. Fordun who, however, has simply 'Michael Scot' (though the index of the ed. of 1759 adds 'Balveriae'). Boece (XII, *ad init.*) speaks of Ioannes instead of Michael Scotus.

[2] Fordun, XIV, c. iii.

[3] A verse of this is quoted in the article referred to p.43, n.1, as follows:
What gars ye gaunt (i.e. yawn), my merry men a'?
What gars ye look sae earie?
What gars ye hing your heids sae sair
In the castle of Balwearie?

[4] Cf. Haskins, 277.

[5] *Melanges de philosophie juive et arabe* (Paris, 1859) 520-521.

[6] *Systeme du monde*, II, 145-156.

[7] Or al-Bitrauji.

certainly known, but a general indication is given by the death of Ibn Ṭufail, the teacher of Alpetragius, in 581/1185. Michael Scot was the first translator of the work *On the Sphere*. It was then rendered into Hebrew in 1259 and later, as sometimes happened, from Hebrew into Latin (1529)[1]. These facts serve to show the general usefulness of the work over a surprisingly long period and Scot's originality, a quality which is not to be denied him, in selecting it for translation. He was helped in his translation, as he tells us, by the Levite Abuteus, i.e. a Jew called Abū Dā'ūd, who may or may not be the same as the Jew Andrew (Andreas)[2] who according to the text of Roger Bacon worked on these translations with Michael Scot.

Bacon asserts that Michael Scot was equally ignorant of natural science and languages, and that the Jew Andrew did most of the work[3]. But Bacon's own *forte* was certainly not Oriental languages, and he rarely speaks other than grudgingly of the translators. In using the assistance of an expert in Arabic, presumably a native Arabic speaker, Michael Scot was doing what most of his predecessors in this field had done and what evidently gave the best results. We must always allow that however much or little Arabic these men knew, the initiative undoubtedly came from them. It is quite clear that without the scholars who went to Spain and elsewhere in search of Arabic manuscripts, the Latin versions which were so eagerly read from this time on would never have been made, for neither native Arabic speakers nor stay-at-home philosophers and theologians were in a position to produce them. For these reasons Roger Bacon's criticism of Michael Scot and others, so far as knowledge of Arabic is concerned, though difficult from the

1 Brockelmann, *Geschichte der arabischen Litteratur*, *Supp.* I, 866.

2 Cf. Haskins, *op. cit.*, 18; Millas Vallicrosa, *Traducciones*, 201.

3 Similiter Michael Scotus ascripsit sibi translationes multas. Sed certum est quod Andreas quidam Judaeus plus laboravit in his. Unde Michaelus (*sic*) Scotus, sicut Heremannus (*sic*) retulit, nec scivit scientias neque linguas (*Compendium Studii*, ed. Brewer. 472). Roger Bacon has evidently adopted the opinion of Michael Scot held by Hermann (Alemannus), another translator from Arabic (cf. below). The following passage 'Michael Scotus, ignarus quidem et verborum et rerum, fere omnia quae sub nomine ejus prodierunt ab Andrea quodam Judaeo mutuatus est' is not independent of the other and is not to be found, as has sometimes been said, either in Bacon's *Opus Maius* or in his *Opus Tertium* (cf. Renan, *Averroes*, 209), but is simply a paraphrase of the other, given by Jebb in the Latin preface to his edition (1733) of the *Opus Maius*. Cf. also *Opus Tertium*, ed. Brewer, 91.

nature of the case to confirm or deny, seems somewhat captious and beside the main point, which is that they did bring valuable new material and a new orientation into learned discussions in the Latin West. No work, scientific or any other, was ever perfect, and no claim for perfection can be made for the Latin Arabists. But on any unprejudiced view what they did must appear a very solid contribution, as the mere number of the works translated shows. It may well be that Bacon was disappointed in the new Arabist texts because they seemed to promise much, yet did not give him the kind of information he required. The ultimate source of Arabic science was, as we saw, Alexandria, and Alexandrian science in its later stages tended to be speculative rather than experimental. The Arabs doubtless in this respect made some improvement. But, given the original tendency and the imperfections of the Latin versions, made in general by non-scientists, Bacon's criticism becomes understandable. One would suppose indeed that Michael Scot, who became one of the most successful scientific practitioners of his day, was less exposed to it than other translators. But perhaps Bacon felt that Scot's scientific reputation was exaggerated.

However this may be, the work of Alpetragius translated by Michael Scot and called in Arabic *Kitāb al-hai'ah* (*Book of the Form*, sc. of the heavens) was concerned in principle with a criticism of Ptolemy's celebrated theory of eccentrics and epicycles to account for the observed movement of the heavenly bodies, and with a development of Aristotle's view of homocentric spheres[1]. In this al-Biṭrūjī was not without predecessors among the Arabs. In his preface[2] he mentions in particular two earlier critics of Ptolemy. One of these, Abū Isḥāq Ibrāhīm b. az-Zarqālah (Arzachel) of Cordova, was a successful practical observer and instrument-maker as well as theorist. He flourished 420/1029 to 480/1087. The other principal predecessor of Alpetragius, according to himself, was Abū Muḥammad Jābir b. Aflāḥ al-Ishbīlī, who flourished in Seville in the middle of the twelfth century. As already indicated, the importance of the work of

[1] So Haskins, 277.

[2] Jourdain, *Recherches sur les anciennes traductions latines d'Aristote* (Paris 1843), 451.

Alpetragius was considerable. It was frequently referred to in the thirteenth century by Albertus Magnus, Vincent of Beauvais and, in spite of his criticism of the Arabists, Roger Bacon, evidently in Michael Scot's version,[1] for there was no other available. Later Copernicus quotes Arzachel (also Albategnius) in his *De Revolutionibus Orbium Coelestium*[2]. We thus see Michael Scot mediating important work on astronomy which had been done and was still being done in Muslim Spain in the twelfth century. The earlier source of the movement was further east, in the central provinces of the Caliphate.

Some time later the *De Coelo* of Aristotle, accompanied by what is generally known as the Middle Commentary of Averroes, was translated by Michael Scot[3]. When Averroes wrote his commentary is not altogether clear, perhaps at Seville in 1171[4]. It appears to have been rendered into Latin by Michael Scot, probably in Spain, not very long after 1217. The Latin translation is dedicated to a certain Stephen of Provins. In his preface Scot makes the comment: 'if Aristotle has left anything incomplete in his account of the constitution of the world in this book, you may supply it from the work of Alpetragius which I have put into Latin dress, and with which you are already familiar'.[5] It would seem that here is no undue respect for Aristotle. To the subject of the celestial sphere, which obviously interested Scot greatly, we shall find him returning in a work belonging to his Italian period.

Another translation which can be dated with some precision is his version of the *Historia Animalium*. A note in more than one manuscript of the work shows that it was completed before 21 October, 1220 [6], at which date the author was in Bologna, as already mentioned. The Arabic original lumped together most of the zoological works of Aristotle,[7] and thus even if it is a

[1] Jourdain, *op. cit.*, 132; Haskins, 277.
[2] Carra de Vaux in *Legacy of Islam* (Oxford, 1931), 395.
[3] M. Steinschneider, *Die europaischen Ubersetzungen aus dem Arabischen, Sitzungsberichte der phil.-hist. Klasse der k. Akademie d. Wissenschaften*, B. 140 (Vienna, 1905), 56 (reprinted Graz, 1956).
[4] Renan, *op. cit.*, 61 cf. L. Gauthier, *Ibn Rochd* (Paris, 1948), 13 (grand commentaire).
[5] Jourdain, *op. cit*, 127-128.
[6] Haskins, 277.
[7] I.e the *De Animalibus Historia*, including the spurious 10th Book, the *De Partibus Animalium* and the *De Generatione Animalium*—in all 19 books (Haskins, 278).

paraphrase[1] rather than a translation, is of considerable bulk. From this point of view alone the Latin version is something of an achievement. But Michael Scot's realisation of its importance again shows his originality. The text on which he worked had long been in existence, having been rendered into Arabic by Yaḥyā b. al-Biṭrīq in the ninth century. Scot's Latin translation had the distinction of being the first. It came into general use at once and held its ground till the fifteenth century. There are still services which this version by Michael Scot can render, for it is sufficiently complete and accurate to have been used in more than one instance for restoring the Greek text of Aristotle by a modern editor[2].

Averroes in his work on Aristotle produced three kinds of commentaries. The shortest were simply analyses. The so-called Middle Commentaries, of which one has just been mentioned, followed the order of the original work paragraph by paragraph, but the words of Aristotle were not given *in extenso*. This inconvenience was remedied in the Great Commentaries, which offer the full text of Aristotle, with a systematic exposition of all details, and digressions in which relevant matters are discussed. Michael Scot is usually admitted to have translated the *De Anima* of Aristotle with the Great Commentary of Averroes.[3] This constantly accompanies the *De Coelo* in the manuscripts, though nowhere apparently stated explicitly to be his work, unlike the other. It is virtually certain that further works of Aristotle with the commentaries of Averroes were also translated by Michael Scot, though hesitation has been felt to affirm this because of the absence of direct attribution in the manuscripts. In this category come some or all of the following: the *De Generatione et Corruptione*, Book IV of the *Meteora*, the *De Sensu*, the first treatises of the *Parva Naturalia*, the *Physics*, *Metaphysics* and *Ethics*, as well as a short work of Averroes, *De Substantia Orbis*.

We shall restrict ourselves here to the *Physics*, *Metaphysics* and *Ethics*, which are of course the most important. The tendency has

[1] M. Steinschneider, *Die arabischen Ubersetzungen aus dem Griechischen*, *Beihefte zum Centralblatt fur Bibliothekswesen*, B. 4 (Leipzig, 1893), 64 (reprinted Graz, 1960.) Cf. B. Lewin in *Oriens*, V 356 (1952).

[2] A.L. Peck in the Loeb Aristotle, *Parts of Animals* (1937), 46 ff; *Generation of Animals* (1943), XXIII ff. XXIX ff. Cf. Rudberg, *Eranos*, IX 92 ff. (cited Haskins, 278, n. 36).

[3] Haskins, 278; Steinschneider, *Die europaischen Ubersetzungen* 57.

been gaining ground to admit Michael Scot's authorship. In the Latin Aristotle, begun in 1939 by the Union Academique Internationale, the editors consider that the best opinion assigns to him a translation of the *Physics* with the Great Commentary of Averroes, and regard the *Metaphysics* as also due to him.[1] The argument for the *Metaphysics* is specially strong. It seems to have been a digression in *Metaphysics*, Book XII, with the heading 'Quaestiones Nicolai Peripatetici' that on one occasion called forth the anger of Albertus Magnus against Michael Scot, whom he mentions by name as the author.[2] Albertus here repeats the charge of Roger Bacon that Scot knew nothing of science, in almost similar terms.[3] This did not prevent Albertus from making the most extensive use of him, as we shall later see.

That Michael Scot translated the *Ethics* was not admitted in his day by the bibliographer Moritz Steinschneider, nor more recently by the editors of the Latin Aristotle mentioned above. There are certainly grounds for the denial. Two Arabist versions of the *Ethics* are known. Both appear to be the work of a somewhat later translator, Hermann Alemannus. The longer of the two versions was made at Toledo in 1240 from an Arabic original completed by Averroes in 572/1176, evidently his Middle Commentary.[4] The shorter was done a year or two later, in 1243 or 1244. It is clearly a compendium.[5] While thus Hermann Alemannus apparently translated two works of Averroes on the *Ethics* within a few years, it seems somewhat unlikely that he would have done so if either had been translated before, and we know of no Great Commentary of Averroes on the *Ethics* which Michael Scot might have rendered into Latin. The version in the Juntine Latin Aristotle is certainly by Hermann. Indeed, by the time of the Renaissance all knowledge of

1 *Aristoteles Latinus*, I (Rome, 1939), 65, 104.

2 Renan, *op. cit.*, 209.

3 'Michael Scotus qui in veritate nescivit naturas nec bene intellexit libros Aristotelis,' *Alberti Magnirei Opera* (Paris, 1890), IV 697 (cited Haskins, 279, n. 45). Cf. p. 47, n. 3.

4 *Aristoteles Latinus*, I, 117.

5 Steinschneider, *Die arabischen Ubersetzungen*, 70, *cf.* Jourdain, *op. cit.*, 144.

a version by Michael Scot, if it ever existed, seems to have disappeared, for Leonardo Bruni, who made a new translation from the Greek, thought that there were only two translations of the *Ethics* before his own, one Arabist, viz. Hermann's, and one from Greek, presumably that by Robert of Lincoln (Grosstete), which is mentioned as already in existence by Hermann Alemannus.[1] And further Michael Scot himself in what is perhaps his latest work mentions the *Ethics* without saying that he has translated them, and cites the first few words in a version which seems to be from Greek.[2] Yet, as against all this negative evidence, in the *Sentences* of Baconthorpe Michael Scot is cited by name for a proposition about legal justice, with a reference to *Ethics*, V, 3. Baconthorpe, called in his time (first half of the fourteenth century) the 'prince of Averroists' should here, unless he is in error, be quoting a commentary of Averroes on the *Ethics* translated by Michael Scot.[3]

It is at all events clear that substantial parts of Aristotle with Averroes' commentaries were rendered into Latin by Scot. Millas Vallicrosa has called attention to an important piece of evidence in a manuscript of the Biblioteca Nacional, Madrid, viz., a thirteenth century inventory of books belonging to a Spanish bishop.[4] One of the items here is 'All the commentaries of Averroes except a few, in the autograph of the translator,' immediately followed by 'Six parts of the book *De Animalibus*, written in the hand of the translator.' There is little doubt that Michael Scot is intended. The date is 1273, i.e. presumably about fifty years after the works had been translated. The inventory was made at Alvaladiel, a few miles from Toledo, and it was doubtless there that the translation was carried out, or at all events somewhere in Spain.[5] This notice has to be taken with the

[1] Jourdain, 140. [2] Haskins, 284, n. 78; Jourdain, 179, 436, 437.

[3] 'Contra aliam opinionem quae ponit tantum iustitiam legalem esse in voluntate et nullam aliam, arguo sic. Eustratius et etiam Michael Scotus, 5 Ethic. commento 3, dicunt quod iustitia legalis se habet ad alias virtutes sicut genus ad species, et est communis virtus.' (*Liber Sententiarum* III, dist. 33. quaest. 3, art. 1 iii). Eustratius is Eustratius of Nicaea (c. 1050-c. 1120), whose commentary on the *Nicomachean Ethics* was available in Latin (Basile Tatakis, *La philosophie byzantine, Histoire de la Philosophie, Fasc. Supplementaire No. II*, Paris, 1949, 217).

[4] Millas Vallicrosa, *op. cit.* 17.

[5] Cf. '....incipit tractatus libri quem composuit Aristotles in cognicione naturarum animalium....a magistro Michaele Scoto apud Tholetum translatus,' MS. Merton Coll., 0278, cited G. Furlani, 'Le antiche versioni araba, latina ed ebraica del *De Partibus Animalium* di Aristotele,' *R.S.O.* IX (1921-23), 238.

passage from Roger Bacon already referred to, according to which from the time of Michael Scot, who appeared after 1230 with parts of the books of Aristotle on natural philosophy and metaphysics, together with certain commentaries, the philosophy of Aristotle has been highly prized by the Latins. Undoubtedly Bacon had the translation from Averroes in mind. Bacon, as we saw, was by no means prepared to concede to Scot more than his due. It is plain that his contribution to knowledge made, *inter alia*, by the translations from Averroes was a considerable one.

We now turn to Michael Scot's other writings, including original works. His *Divisio Philosophiae* was based on a work of similar title by Dominicus Gundisalvi, which in turn owed much to the *Ihṣā' al-'ulūm* (*Enumeration of the Sciences*) of āl-Fārābī. Scot's work is known only fragmentarily[1]. It is likely that it belonged to the Spanish period of his life. On the other hand, the *Abbreviatio Avicennae de Animalibus* (like the *Historia Animalium*, in nineteen Books) is dedicated to Frederick II. It is conjectured to be a rendering of the zoological part of Avicenna's encyclopaedia *ash-Shifā'*.[2] The presumed Arabic original is still to a great extent in manuscript, unlike Michael Scot's translation, which was printed more than once during the Renaissance. The two have never, it seems, been compared, so that the identification remains uncertain. In the best manuscripts of the *Abbreviatio Avicennae de Animalibus* the Arabic words in Latin dress, with which the work abounds, are glossed in the margin and collected at the end.[3] It would be instructive to compare this list with existing glossaries from the twelfth and thirteenth centuries made by other translators. Specimens of the *Abbreviatio* were Englished by Wood Brown in his book on Michael Scot. It is natural enough to find Scot engaged on such a work for a patron who is known to have been interested in natural history and was himself the author of a *De Arte Venandi cum Avibus*, which is as much zoology as falconry.[4]

[1] So Haskins, 279. Ludwig Baur, *Dominicus Gundissalinus, De Divisione Philosophiae, Beitrage zur Geschichte der Philosophie des Mittelalters, Band* 4 (Munster, 1903), gives the fragments of an Introduction to Philosophy by Michael Scot, surviving in the *Speculum Doctrinale* of Vincent of Beauvais.

[2] Steinschneider, *Die arabischen Ubersetzungen*, 65.

[3] Wood Brown, 58.

[4] Haskins, 299 ff.

Dedicated likewise to Frederick is what has been called Scot's *magnum opus*, a composite work in three parts, dealing mainly with astrology. The treatises of which it is made up—*Liber Introductorius*, *Liber Particularis* or *Astronomia* and the *Physionomia* or *De Secretis Naturae*—are sometimes reckoned as separate books, and perhaps originally were so. The longest of the three is the *Liber Introductorius*. Like the *Liber Particularis* it has never been printed, while the *Physionomia*, which includes an account of generation and a discussion of prognostications from dreams, complexions and the different parts of the body, appeared repeatedly in a number of early editions. All three have been studied within recent years.[1] In general, these treatises represent an unsystematic compilation from many sources in which it cannot be said that Arabic works entirely predominate. Science in the sense of original observation and experiment is found side by side with that seems to us the grossest superstition. In the final form of the composite book we have what is apparently the latest work of Michael Scot. It is somewhat surprising that with much experience, as can hardly be doubted, of the discipline of translation, the author was apparently unable to give a more coherent account of the matters with which the treatises are supposed to deal. If the tripartite work is to be regarded as Michael Scot at his best, the rather unfavourable judgments passed on him by Lynn Thorndike and C.H. Haskins, as well as the more sweeping mediaeval condemnation which we have already noticed, may seem justified.

A more favourable impression is to be gained from the dedication to Michael Scot, with great profession of respect,[2] of the work *On the Abacus* by Fibonacci and from his own work on the *Sphere* of Sacrobosco (John of Holywood). There has been doubt as to whether the *Commentary on the Sphere* can be an authentic work of Michael Scot, since the original was thought to have been written in 1256, by which time Scot, as we saw, was dead. But with the date of Sacrobosco's *Sphere* now given as 1233,[3] there is no

1 Lynn Thorndike, *op. cit.*, II, 316ff.; Haskins, 285ff.

2 Haskins,272.

3 Mieli, *op. cit.*, 61.

reason to suppose that Michael Scot was not the author, particularly since we have already seen him as translator of other works on the same or a similar subject. The *Questions on the Sphere of Sacrobosco* as the *Commentary* is often called must be taken as corresponding to Michael Scot's direct interests. We may agree with Bernardino Baldi[1] that he there handled the arguments admirably and gave proof of real mathematical knowledge and understanding. This opinion of the sixteenth century Italian mathematician is echoed in the nineteenth century by the historian of mathematics Libri, according to whom the author of the *Commentary* must have been far in advance of his time[2].

We have also to consider Michael Scot as alchemist. Alchemical works are attributed to him in manuscripts, and it is at all events clear, as can be seen from a long passage in the *Liber Particularis*, that Scot was interested in alchemy.[3] The question is: Did he write definite works on the subject? The most promising evidence, according to Haskins in 1927, was a few pages of manuscript in Corpus Christi Library, Oxford, which contain a short treatise *De Alchimia* attributed to Michael Scot. Later Haskins himself investigated this work.[4] There seemed to be invincible difficulties, connected with the proper names therein cited, against regarding it as other than apocryphal. In the first place, the *De Alchimia* is dedicated to 'Theophilus, king of the Saracens.' 'Theophilus' of course is Greek, and it seemed impossible to extract from it a reference to any Muslim ruler of the period. Nor can anything be made of other proper names, as they stand in the Oxford manuscript: 'Theodosius, the Saracen of Cunusani,' 'Medibibaz, the Saracen of Africa,' etc. A work in which such incomprehensible names are cited has all the appearance of being bogus. The situation in this respect was changed a little later, when Mrs. Singer published from a manuscript of Caius College, Cambridge, another text of the *De Alchimia*.[5] This

[1] *Vita e opere*, Pistoia, 1908; in *Emilia Collezione storico-letteraria*, ed. Guido Zaccagnini (Reggio, 1918), 346-349. I owe this information to Mr. Michael Scott, Tangier.

[2] Cf. Wood Brown, 146.

[3] Haskins, 295.

[4] C. H. Haskins, 'The "Alchemy" ascribed to Michael Scot,' *Isis*, X (1928), 350-359.

[5] D. W. Singer, 'Michael Scot and Alchemy,' *Isis*, XIII (1929-30), 5-15.

MS. dates from the thirteenth century, and contains readings of the proper names which, it they still present difficulties, are at all events now recognisable as Arabic. For in the Cambridge manuscript 'Theophilus' appears, not as 'king of the Saracens' but as a *qā'id* (general) in Tunis[1], 'Medibibaz' assumes the form 'Modifar,' evidently for 'Muẓaffar', while instead of 'Theodosius, the Saracen of Cunisani' we now read 'Theodorus of Tunis'. Michael Scot appears to mention Tunis in the *Liber Introductorius*[2], and it is certain that friendly connections existed[3] between Frederick and the newly established Ḥafṣids, who ruled the African city from A. D. 1228. The people mentioned in the *De Alchimia* cannot be identified in literary sources, but there is no reason to suppose that they are necessarily figments.

As to the contents of the work, the method of 'Modifar' (Muẓaffar) for changing lead into gold may be found at length in Wood Brown's book. It appears to involve the use of sympathetic magic: red earth of various kinds, the blood of a ruddy man, and roots of coral are among the ingredients given[4]. In the text as it stands Michael Scot claims to have tested the formula many times. Certainly belief in transmutation does not in any way discredit the scientific standing of a man of this age, though there is no proof as yet that Scot was an adept. Among the Arabs alchemical works are attributed to Maslamah of Madrid, who was without any doubt an eminent astronomer and one of those responsible for the celebrated 'Toledan Tables'. The possibility of transmutation was not doubted by the philosopher al-Fārābī[5] (though denied by his predecessor al-Kindī[6], who himself made chemical experiments[7], and by Avicenna). On this Ibn Khaldūn remarks cynically that, generally speaking, those who have been interested in alchemy were poor men,

1 'Magistro Teophilo gayto Saracenorum tecum Tunisie'.

2 'Tenisti' (Haskins, 290, n. 114).

3 Haskins, 247, 252.

4 Wood Brown, 93.

5 Al-Fārābī's *Kitāb fī wujūb ṣinā 'at al-kīmiyā* (*Book on the Necessity of the Art of Alchemy*) is in Leiden Arabic MS. No. 1270. It has been edited with a Turkish translation, *Belleten*, XV (1951), 65-79.

6 Mas'ūdi, *Murūj adh-Dhahab*, ed. Paris, VIII, 176.

7 Cf. *Kitāb fī Kīmiyā al-'iṭr wat-taṣ'idāt* (*Book on the Alchemy of Perfume an Distillations*) edited by Karl Garbers (*Abhandlungen fur die Kunde des Morgenlandes*, XXX, 1948), especially, 33, 66.

and that this explains the difference between al-Fārābī, the indigent scholar, who affirmed its possibility, and Avicenna, the rich vizier, who denied it.

There remains another side of Michael Scot's activity which has not yet been mentioned here, viz. his work on medicine. This has been referred to by some of his biographers, notably Hector Boece[2] and Bishop Leslie[3], but has remained practically undocumented. The gap can to some extent be filled up from the *Breviarium Practicae*, a thirteenth century work on medicine, usually ascribed to Arnold of Villanova, which has been studied recently by Rene Verrier. In the *Breviarium*, where various medical men are quoted, e.g. Magister Petrus Hispanus, Magister Henricus Anglicus, Magister Hector Anglicus and a certain Hibernicus, reference is most frequent to John Casamide (? John of Gaddesden) and Magister Michael Scotus.[4] The notices of Michael Scot are of considerable interest.

According to Magister Michael Scotus, the cure of ringworm (*tinea*) is as follows. First, let the head be shaved and then washed in strong vinegar. Afterwards it should be wiped dry with a piece of linen cloth (*petia*) and anointed with honey. Then sprinkle it with powdered ashes of barley prepared in a new pot, and on the third day let the head be again washed with lye or with warm vinegar.[5]—The present writer has no means of knowing if this treatment ascribed to Michael Scot is likely to be effective, but it is evidently less drastic than the use of sulphurous acid, or of corrosive sublimate, indicated for the same condition by much more modern authorities.

For weak and watery eyes, says the *Breviarium Practicae*, we may apply the following remedy, devised by Michael Scot for weakness and swelling (*panus*) of the eye. Take a good theriac (sc. a compound remedy including opium) and mix with a small quantity of good white wine. Apply to the eyes several times a day for several days. This will have a marvellous effect.[6]

1 *Muqaddimah*, 531, cf. 527; transl. F. Rosenthal, 280, cf. 272.
2 Cf. pp. 43, 44 n.
3 Cited Wood Brown, 152.
4 R. Verrier, *Etudes sur Arnaud de Villeneuve* (Leiden, 1949), 18ff.
5 *Brev. Pract.*, I., c. 23.
6 *Ibid.*, I., c. 28.

Film and cataract necessitated more serious measures. For persistent film the following treatment was devised by Magister Michael Scotus. Take equal parts of balsam, sea-foam, the dung of a green lizard, nitre and sugar, with three to ten parts of iris-root and celandine. Boil in 1 lb. of water till three-quarters evaporate. Strain ....and dry in the shade. Triturate....and apply the powder to the eyes. There is nothing like this remedy for removing persistent film and thick scale (*albugo*) from the eyes of men and all animals, horses or any other you please.[1]

For rupture, which, according to the *Breviarium Practicae*, often occurs in young and robust men who leap too far, run too fast, carry great weights, throw heavy stones or raise them high in manly fashion, or who shout too loud and high, relief may be found by the use of the powder of certain electuaries and by remaining in a recumbent position, as has been proved by John Casamide and Michael Scot.[2]

The same two authorities recommend another powder which is a wonderful cure for scrofula, as follows. Take aloes-wood, bored pearls, the hard tissue from the heart of a stag, spikenard, cloves, galingale, frankincense, coriander-seed, *nux muscata*, pepper and scammony, of each three parts to one of amber (2 grains), and three parts of the plant euphorbia. Triturate each separately and pass through a sieve. Then take of the mixture what a nut-shell will hold, with cold water, for fifteen or twenty nights. This will remove the complaint by purgative action.[3]

As a final sample of Michael Scot's remedies, here is a powerful anaesthetic. To induce sleep strongly, take good Egyptian opium, rind of mandragora, with henbane-root in the proportion of three to one. Triturate, shake with cold water and allow to settle. Now if you wish to saw or cut the patient open without his feeling pain, place a piece of linen in the liquid and moisten his brow from one ear to the other, and at the same time the nostrils.

1 *Brev., Pract.*, I, c. 30.
2 *Ibid.*, II, c. 44.
3 *Ibid.*, II, c. 5.

The patient will immediately sleep, and you will be able to do as you please. When you wish to revive him, dip a cloth in strong vinegar, place it upon his nostrils, and he will at once waken. This is of great value in cases of mania (*phrenesis*), when it is necessary that the patient should sleep.

It will have been noticed that the remedy against scrofula is to some extent magical. The amber and pearls and perhaps other ingredients are to be used for the difficult cure evidently because of their high value. In general, Michael Scot's pharmacopoeia includes some startling ingredients. On the other hand, there is no trace here of astrological medicine, which Scot himself refers to elsewhere.[2] The basis of these remedies is no doubt the Arabist medicine then coming into fashion, for which texts like the *Kitāb al-Manṣūrī* (*Liber ad Almansorem*, *Liber Almansoris*) of Rhazes and the yet more famous *Qānūn fī'ṭ-ṭibb* (Canon of Medicine) of Avicenna were already available in translations made by Gerard of Cremona. The impression which we get of Michael Scot's medicine, considering the general level of the times, is not unfavourable. It is not surprising to read that he effected cures in difficult cases of leprosy, gout and dropsy.

Summing up, what seems most remarkable in Michael Scot is the extent and variety of his scientific activity. No important scientific discovery is associated with his name, and probably his greatest single achievement was the opening up of the study of Aristotle in the West, so far as this was brought about by his translation of the commentaries of Averroes and other works. Even here he does not stand alone, for there were other translators from Arabic and Greek who contributed to the new knowledge of Aristotle. Nor was the introduction of Aristotle an unmixed blessing, for it seems to have led directly to the development of the scholastic philosophy, which engrossed the best minds too exclusively after the 13th century. Yet when we consider that Michael Scot's interests included notably astronomy and astrology, but also zoology, medicine, etc., as well as philosophy, and that his written works deal with practically all

1 *Brev. Pract.*, IV, c. 10.
2 In the *Liber Introductorius*. See Lynn Thorndke, *op. cit.*, II, 323-324.
3 Cf. Wood Brown, 153.

the scientific preoccupations of the age and merely in point of bulk, as we now see, form an impressive record of effort and achievement, it is difficult, or rather impossible, to withhold our admiration. Evidently the mountains which this man moved and the superhuman tasks he performed existed only in the imagination of simple people. But these legends seem to reflect the passage across the stage of the 13th century of a remarkable personality, whose real labours command respect and were not without usefulness to future generations. Without any doubt, the basis of the activity of Michael Scot lay in Arabism, and to the Arabic texts in their original form or in translations his recourse is constant throughout the whole widely diversified range of his production. In the foregoing account we have not attempted to show his sources in detail. But it may safely be taken that the work of Michael Scot is typical of the Arabist movement in the Middle Ages, and that there are few, if any, other authors whose writings afford better means of judging the movement as a whole.

III. Albertus Magnus, Philosopher

Another famous author in whom the effect of the Arabist movement in the 13th century can well be seen is the celebrated Albertus Magnus. His life-story in broad outline is easily told. Born in Suabia and son of a count of Bollstadt, he early joined the Dominican order with which his life thereafter is identified. Eventually becoming provincial of his order and bishop of Regensburg (Ratisbon), he resigned the latter dignity after three years, in order to devote himself to teaching. The early part of his career seems to have been spent mainly in teaching and writing on theology. Philosophy and natural science claimed his middle years, while the latter part of his life was engrossed by administration.[1] He had the distinction of being the master of Thomas Aquinas and died at an advanced age in A.D. 1280.

The 19th century botanist Jessen, who, as a diligent student of that part of the work of Albertus which dealt with his own branch was well qualified to judge, has left a memorable tribute.[2] 'Albertus of Lauingen, of the family of Bollstadt,' says Jessen, 'a man not inferior to Aristotle in genius and learning, and whom his contemporaries called "the Great," ' justly admiring that most learned man's modesty and piety, far removed from pride and superstition, has been so neglected by later generations that he has been called a magian and fabulist even by the most eminent scientists, who without due investigation have attributed to him spurious books, full of trifles and old wives' tales. Hence it is that the pioneer of natural science in the West, who first assimilated the sources of Greek wisdom to the Christian religion, who first put natural history on a level with ecclesiastical doctrine......who first attempted to give a rational morphology of the forms of created things, who indeed first unfolded a complete account of the whole of nature, has been disdained as a vain and garrulous imitator, and the century in which

[1] G. Sarton, *History of Science*, II, 936.

[2] *Alberti Magni De Vegetabilibus* (Berlin, 1867).

Albertus rose to true distinction has been regarded as occupied solely with scholastic disputations.' This is high praise for Albertus, and if, as we shall attempt to show, he drew extensively on Arabist works of all kinds (not being confined, that is, to versions of Aristotle from the Arabic), the credit for his success is due at least in part to the translators. The importance of the Arabist movement is readily seen when we consider the system of Albertus, raised to a great extent on Arabist texts as bases and in any case inconceivable without them.

The charges which Jessen here sets aside, that the later Middle Ages were entirely given over to fruitless theological disputation and that Albertus was merely, as he has been called, 'the ape of Aristotle,' are not new. To understand what he was really trying to do in his main scientific work, we cannot do better than quote his own words.[1] "Our intention in natural science," says Albertus, "is to satisfy as far as we can the brethren of our order, who for many years past have been asking us to compose a book on physical matters in which they may have a complete natural science, and from which they may gain a competent understanding of the books of Aristotle. Though we consider ourselves inadequate, yet being unable to disregard the requests of the brethren, we are at last assenting to the task which we have so often refused, and yielding to the requests made by some, have undertaken it, first to the glory of the omnipotent God, who is the source of wisdom and the begetter, creator and ruler of nature, and for the use of the brethren, and next for the use of all who read it and desire to attain a knowledge of nature."

"Our method will be to follow Aristotle's order and thought and to give in explanation and proof whatever will seem necessary, but without any mention of his text. In addition to this we shall introduce digressions, making clear any doubts which occur, and supplying whatever has been said less clearly and caused the thought of the philosopher to be obscure for some. We shall divide up the whole work by means of chapter-headings. Where the heading shows simply the subject-matter of the chapter, it indicates that this chapter belongs to the series of the books of Aristotle, but where

[1] *Alberti Magni Physica*, I, i, 1 (Jessen, *op. cit.*, xxv).

the title indicates a digression, it is an addition of ours, with a view to supply additional matter or by way of proof. In this way we shall complete the books to the same number and with the same names as Aristotle. We shall also add in some places parts of books which were incomplete, and in other places neglected or omitted books which Aristotle did not write, or if he wrote them, have not reached us. But where this happens the (title of the) treatise will make it clear."

This is a coherent and modest statement of what Albertus proposes to do in a vast undertaking. His attitude to Aristotle, whose words are not to appear throughout, can scarcely be said to be slavish. The right to criticise is safeguarded explicitly by mention of the digressions, which are to be an essential part of the work. Doubts will occur, and there are obscurities to resolve. To say more at the beginning of a book intended primarily for members of a religious order for whom obedience and intellectual assent to authority remained virtues, might well seem out of place. When once in full flight Albertus will show that he is not bound by Aristotle, but is prepared to follow wherever the argument, as it seems to him, with fresh knowledge from other new-found sources, will lead. Aristotle provides the framework of his system, but most of what the thirteenth century knew, or thought it knew, will find a place in his pages, as we shall see.

As already indicated, the extent to which Albertus utilised Arabist works in developing this programme is very considerable. Here we shall restrict ourselves for the most part to his zoology, botany and mineralogy. It is convenient to begin with the zoology in the *De Animalibus*, though this was written by Albertus after his principal works on mineralogy and botany.[1] The *De Animalibus* is in no less than twenty-six Books, occupying 1600 pages in the modern edition of Stadler (1920).[2] By far the greatest part is drawn from Arabist sources. Michael Scot's translation of the Arabic *Historia Animalium*, together with the same author's *Abbreviatio Avicennae*, was of course now available. So was the *Canon of Medicine* of

[1] Jessen, xxxii.

[2] *Beitrage zur Geschichte der Philosophie des Mittelakers*, XV—XVI (Munster 1916 and 1921).

Avicenna, which had been translated by Gerard of Cremona in the previous century. It is not very surprising to find that Books 1—19 of Albertus follow Michael Scot's rendering of the *Historia Animalium* very closely and are supplemented in the anatomical portions by extensive appropriations from the *Canon* of Avicenna and the *Abbreviatio*.[1] These first nineteen Books of the *De Animalibus* of Albertus amount to rather more than three-quarters of the whole work. Without the Arabist sources they simply disappear.

The case is different for the remainder. Books 20—21 are philosophical discourses of a general nature, probably due to Albertus himself.[2] Books 22 to the end are based on Thomas of Cantimpre,[3] a contemporary, and contain lists of animals (Book 22), birds (Book 23), fishes (Book 24), reptiles (Book 25) and 'worms' as Albertus calls insects (Book 26). Though in these last Books he is following a Latin source, even here some of the material is ultimately from Arabic, as appears from numerous Arabic words more or less obvious in spite of their Latin dress, e.g. *algazel* for 'gazelle,' *alfech* for 'panther' (Arabic *al-fahd*), *seraph* for 'giraffe' (Arabic *zarāfah*), etc. It is noticeable that these Arabisms occur so to say exclusively in Books 22, 25 and 26, i.e. for exotic animals unknown in the West and for reptiles and insects as yet without a fixed nomenclature. Birds and fishes, on the other hand, have, like the common animals, native or at least Latin names.

One of the subsidiary authorities used by Albertus in the *De Animalibus* is a certain 'Gyrgyr,'[4] a name at first sight baffling. By comparison with a passage in the *De Mineralibus* where 'Gilgil' is named, as from the city of Seville in Spain and author of a scientific work,[5] it would seem that this Gyrgyr or Gilgil is the medical man Ibn Juljul, who practised at the court of the Umayyads in Cordova during the 10th century A. D. It is from Ibn Juljul that we hear how Dioscorides, the famous Greek botanist, was first correctly interpreted in Arabic in Spain[6]. Ibn Juljul was also

1 Stadler, *op. cit.*, XV, xiii.

2 Stadler, XVI, V.

3 *Ibid.*

4 *De Animalibus*, XXII, 117.

5 *De Mineralibus*, III, i (*Alberti Opera*, ed. Jammy, II, 247): '*in secretis suis*'.

6 Ibn abī Uṣaibi 'ah, ed. Muller, II, 46ff.

interested in the *History* of Orosius, one of the few Latin books translated into Arabic in the mediaeval period, and perhaps the only work of classical Latin literature to be so translated. One may see what Vergil looked like when rendered into Arabic in tenth century Spain from a quotation in the translation of Orosius. This has recently been studied in an apparently unique MS. in New York by Professor Della Vida.[1]

Another source for the *De Animalibus*, rather frequently cited throughout the work, though from the nature of the case not basic is the *Problems* of Aristotle, which are of miscellaneous character and by no means confined to zoology. Here at any rate Albertus may have been independent of Arabs and Arabists, since this work of Aristotle though apparently translated into Arabic,[2] hardly passed from Arabic into Latin. The version used by Albertus had no doubt been rendered fairly recently from the Greek.

Quite uncertain is his authority 'Jorach' or 'Jorach the Chaldaean,' who so far has defied all attempts at identification. An alternative form of the name is Jorath. This might suggest the well-known ninth-century man of science, Thābit b. Qurrah aṣ-Ṣābi', who appears in Western works as Thabit ben Corath or simply as Alcorath.[3] Jorach or Jorath is, however, explicitly cited by Albertus as author of a work *De Animalibus*,[4] and no such work seems to be ascribed to Thābit b. Qurrah. While it is arguable that he may have had to do with the translation of a compendium of Aristotle's *Historia Animalium* by Nicholas of Damascus,[5] as he is certainly reported to have improved a rendering of the same author's book *De Plantis* made by Isḥāq b. Ḥunain[6], there is no certainty that Thābit b. Qurrah is intended by Albertus. The latter cites Jorach more than

[1] 'La traduzione araba delle storie di Orosio,' *Miscellanea G. Galbiati*, III, 1951 (*Fontes Ambrosiani*, XXVII), 185—203, reprinted with additions and amendments in *Al-Andalus*, XIX (1954), 257—293.

[2] M. Steinschneider, *Die arabischen Ubersetzungen aus dem Griechischen*, 74; cf. Jourdain, *Recherches*, 175.

[3] Lynn Thorndike, *op. cit.*, II, 727, 802.

[4] *De Animalibus*, XXII, 16.

[5] Wenrich, *De Auctor. Graec. Version.*, (Leipzig, 1842), 294 (cited by W.A. Greenhill, Smith's *Dictionary of Greek and Roman Biography*, s. v. Nicolaus) cf. Steinschneider, *Die arab. Ubersetzungen*, 64.

[6] Steinschneider, *Die arab. Ubersetz.*, 102.

a dozen times in Books 22, 23 and 25 of the *De Animalibus*, i.e., where he is dependent on Thomas of Cantimpre, as mentioned above, and once in the *De Vegetabilibus*.[1] Jorach is named also by other writers of the period, Bartholomew of England and Vincent of Beauvais.[2]

According to Albertus, Jorach is the author of the extraordinary opinion that the salamander lives in fire.[3] The salamander is mentioned in the classical authors (including Pliny), and its reputed immunity from fire was admitted.[4] But it was reserved apparently for the Middle Ages to assign to it its peculiar habitat (i.e. actually in the fire), and to invent stories of robes made from salamander's wool which could only be cleansed by casting into the flames.[5] Some of the innumerable legends of the mediaeval period, for whatever reason, have had a peculiar hold on men's imaginations, and have been affirmed as fact long after the rest were forgotten. Such is the tale of the barnacle-goose, glanced at and denied by Albertus but still current in the seventeenth century. The salamander story has been equally tenacious of life. It is even given a fresh development in the writings of Paracelsus (16th century), according to whom the salamanders are spirits of the fire, like the sylphs whose native element is the air.[6] In the 18th century the same range of idea is found in the impostor Cagliostro.

If the enigmatic Jorach is author of the salamander story, as Albertus seems to say, he must have written earlier at least than the appearance of the spurious *Letter of Prester John*, which purports to have been sent to the Greek Emperor Manuel (1143—1180) and mentions already the peculiarities of the salamander. Of Prester John's *Letter*, according to Lynn Thorndike, there are actually 12th century manuscripts.[7] It is in any case by no means clear that 'Jorach'

[1] Ed. Jessen, VI, 154, for '*nardus*'.

[2] Thorndike, II, 404; Jessen, 697.

[3] Multi sequentes Jorach philosophum dicunt quod hoc animal vivit in igne, (*De Animal.*, XXV, 36).

[4] Sir D'Arcy Thompson in the *Cambridge Companion to Greek Studies* (Cambridge, 1916), 45.

[5] Charlemagne is reputed to have possessed such a robe (Thorndike, II, 242, n. 4).

[6] *Lib. Philos.*, ii (quoted Franz Hartmann, M.D., *Life of Paracelsus*, London, no date, 121).

[7] *Op. cit.*, II, 240, n. 2.

was an Arabist work. The citations in Albertus are for antelope, dog, hyena and fox, for eagle, the mythical harpy and dove among the birds, and among reptiles for the snake *jaculum* (also mentioned by Pliny), the *prester* or fiery serpent (which comes in Lucan), as well as for *serps, spectaficus, stupefaciens aspis* and viper. These citations suggest a Latin or possibly a Greek original. Again, the Jorach citations come in Book 22, 23, and 25 of the *De Animalibus* of Albertus. We have already seen that he had Arabist words in Books 22, 25 and 26, but apparently not at all in Book 23. The lack of correspondence seems again to indicate that 'Jorach' was not an Arabist work[1]. The salamander story cannot therefore be assigned an Arabic origin on the evidence before us. The word certainly occurs in Arabic in the form *samandar* but this, like many other terms used in the Arabic sciences, is evidently from the Greek.

The botany of Albertus is in his work *De Vegetabilibus*. Here again the basis is Arabist texts—the *De Plantis* (the original of which was ascribed to Aristotle, but is in fact by Nicholas of Damascus), and the *Canon* of Avicenna. The *De Plantis*, translated into Arabic by Isḥāq b. Ḥunain, as we saw, and corrected by Thābit[2], was next translated from the Arabic into Latin by Alfred of Sareshel (Alfredus Anglicus[3]). This Arabist text has a subsequent history which is perhaps unique. It was actually translated back into Greek from Alfred of Sareshel's Latin. The Greek original has never been found, and the Greek re-translation, rendered into English, may now be read in the Oxford translation of Aristotle[4].

Albertus, who used the *De Plantis* in the translation of Alfred of Sareshel, remained under the impression that it was an authentic

1 Yet Jorach Chaldaeus (Thorndike, II, 423) may be the same as Poron Chaldaeus, as suggested by Steinschneider. The work of Poron Chaldaeus *De Animalibus* was to have been printed by the Medici Press in Rome, in the sixteenth century, according to a list which has survived and was published by Libri, *Histoire des sciences mathematiques en Italie*, I 244. The Arabs rendered the name of the Greek philosopher Pyrrhon as Fūlūn (Poron), see the *Ṭabaqāt al-Umam* of Ṣā'id of Toledo (transl. R. Blachere, Paris, 1935, 74), but no work of his on zoology is known.

2 See p. 65, n. 6.

3 Steinschneider, *Die europaischen Ubersetzungen*, 4.

4 A. J. Arberry, 'An Early Arabic Translation from the Greek', *Bulletin o the Faculty of Arts of the University of Egypt*, I (1933), 49.

work of Aristotle. It is the more curious to find him writing at the begnning of the 9th chapter of the *De Vegetabilibus* as follows: 'Everything which has been said from the beginning of this book seems pretty obscure (*satis obscura videntur*), except that part of my own which I gave in the first chapter. I think that this obscurity is the fault of the translators of the books of Aristotle *De Plantis*, whose interpreter and redactor I am. Either they did not understand the philosopher, or perhaps they were not completely at home in the language from which they had to translate.' Albertus goes on: 'So on that account I must recapitulate from the beginning what has already been said and express it more clearly. In this way I shall give a better account of what I think, and the words of the philosopher will be clearer.' There is no question of cancelling the first draft and re-writing it. Albertus simply repeats himself without apology.

Since, broadly speaking, the sources of the *De Vegetabilibus*, like those of the *De Animalibus*, are Arabist, it is natural that Arabic words and turns of expression meet us throughout the work. Balsam, we learn, is found especially in Egypt at a place called Oculus Solis.[1] This is evidently for 'Ain Shams, a well-known locality near the ancient Heliopolis, not far from Cairo. The substance is extracted from the balsam-producing tree after the rising of the star 'Assarahe.' In the Latin 'Calendar of Cordova' another form 'Assahare' occurs and is doubtless more correct.[2] It is Sirius, arabicized as *ash-Shi'rā*, whence directly these Latin forms. Again, the plant fumitory appears in Albertus as *olus regis*.[3] This is a literal translation of the Arabic name for fumitory, *baqlat al-malik*, 'king's herb.' Or we are told that certain plants grow in the land called in Arabic Zahdia, which is very hot.[4] Zahdia appears to be for Zahida, Upper Egypt, the so-called Ṣa'īd. A striking and familiar Arabism occurs in the account given of the plant orpine, which is said to be collected *circa augem solis*.[5] *Augem* is evidently

1 *De Vegetabilibus*, VI, 34.
2 Libri, *op. cit.*, I, 397.
3 *De Veget.*, I, 159.
4 *Ibid.*, I, 166.
5 *Ibid.*, I, 402.

not Latin. The presence of such words in the text of mediaeval writers made the Renaissance scholars very angry, perhaps chiefly because they did not understand them. The men of the Renaissance called a word like *augem* barbarous Latin ('barbaro-Latinum'). It is of course not Latin, but Arabic with a Latin termination. In Arabic *auj* (sometimes pronounced *aug*) means 'summit, zenith'. Inflected forms in the Arabist texts are, as well as *augem*, *augis* or *abgis*, *abge*. It is, it would seem, from the latter inflection that the European languages derive the astronomical term 'apogee'.[1] Yet again, speaking of the sap of plants, Albertus remarks that it resembles what he calls the *nucha* in animals. (The same expression comes in an edition of Albertus made during the Renaissance by the Averroist Zimara as *nuca* or *nuta*,[2] an indication that the Averroists at that time were unfamiliar with the originals of the texts on which they laid the greatest weight.) *Nucha* is in fact correct and exactly reproduces the Arabic word *nukhā'* for the spinal marrow. A further example is what Albertus calls *zinziber caninum*. This is a rendering of *zanjabīl al-kilāb*, dog's bane as we say, but in Arabic 'dogs' ginger'.[3]

Subsidiary authors quoted either directly or indirectly (i.e. by way of the *De Plantis* and the *Canon*) include Benmesauge (Ibn Māsawaih, Mesue) and Constantine Africanus, Abrucalis or Abrutalus, whom Albertus evidently confuses with Protagoras but who is in fact Empedocles,[4] also a certain 'Lycophron whom the Arabs call Lecineon'.[5] This Lycophron or Lecineon is not known elsewhere, and for identification one has to have recourse to the Arabic. The Arabic text of the *De Plantis* was given a good edition in 1933-1934 by Professor A. J. Arberry,[6] and one can there find the equivalent of the perplexing name as *rajul yuqālu lahu Alqnāun*, 'a certain man called Alqnāun,' who said that the earth was the mother

1 Rather than from the Greek *apogaion*, cf. Millas, *Tradncciones*, 202.

2 *De Veget.*, ed. Jessen, II, 51, n.

3 *Ibid.*, VI, 480.

4 Cf. Jessen, *op. cit.*, 6n.; Arberry, *op. cit.*, 50, 62.

5 Or Leucineon, which has been preferred by the editors of Albertus, whose manuscripts here vary. Cf. G. S. Kirk, 'A Passage in *De Plantis*,' *The Classica Review*, N.S., VI (1956), 5-6.

6 See p. 67, n. 4.

of plants and the sun their father. The form of the name and the naivete of the opinion suggest an early rather than a late Greek source. We should here have a reference to the pre-Socratic physicist Alcmaeon.

Albertus also quotes several times the *Metaphysics* of Aristotle. It would be natural enough to expect that he made use of the translation of the *Metaphysics* ascribed to Michael Scot, whose *Historia Animalium* and *Abbreviatio Avicennae* he so largely appropriated in his zoological work. The version which Albertus used has at all events been influenced by Greek. In one citation, speaking of a bald man, he says that he is not *colobon* because of having lost his hair.[1] The word, which looks strange in its Latin context, is of course not Arabic but Greek. The Juntine Latin version of the *Metaphysics* of Aristotle, on the other hand, gives the equivalent *mutilum*.[2] Both renderings mean the same—a bald man is not mutilated in any sense. *Mutilum* may be an improvement on a thirteenth century translator, who simply transliterated the Greek word in an inflected form, made by the Renaissance editor. Certainly the presence of the word suggests that Albertus was using a translation from Greek, and it is generally understood that Michael Scot's versions were from Arabic.

Definite Arabist influence is, however, given by references to the *De Elementis* of Isaac Israeli[3] and the *De Physicis Ligaturis*, ascribed to Qusṭā b. Lūqā.[4] Isaac Israeli was a medical practitioner who flourished in North Africa in the tenth century. His *De Elementis* had been translated by Gerard of Cremona. Qusṭā b. Lūqā of Ba'albak worked in Baghdad and died in Armenia about 300/913. The *De Physicis Ligaturis* ascribed to him appears to have been translated by Arnold of Villanova,[5] who died in 1312 or 1314. Both works were thus available to Albertus in a Latin dress. Mention of the *De Physicis Ligaturis*, the alternative title

[1] *De Veget.*, I, 134.

[2] Juntine ed., V, 27; Bekker, IV, 27.

[3] *De Veget.*, I, 10.

[4] *De Veget.*, V, 118, cf, Thorndike, II, 487.

[5] Steinschneider, *Die europaischen Ubersetzungen*, 6.

of which was *De Incantatione*,[1] leads naturally on to the attitude of Albertus towards magic. Something will be said about this below. Meantime we have to discuss his work *De Mineralibus*.

Albertus begins the *De Mineralibus* by saying that he has not seen the books of Aristotle on the subject except in part, and that what is given by Avicenna is not sufficient. He goes on,[2] 'There are men of great authority in philosophy who, treating not of all but only some kinds of stones, say that they have mentioned them sufficiently, such as Hermes Cuates, king of the Arabs, Dioscorides, Aaron and Joseph, who, discussing only precious stones, have not made mention of their genus. Pliny too in his *Natural History* has given an insufficient account....It is not necessary for us to cite the opinion of each of these, for knowledge of the matter is not so abstruse that we need to assemble it from the errors of many. The natures and complexions of stones will be adequately known when their proper material, efficient cause (*efficiens proximum*), form and proper accidents are known from the methodical investigation in Book IV of the *Meteora*.' The latter, it may be noted, was one of the translations from Aristotle ascribed to Michael Scot, whose work therefore is presumably again referred to here. Albertus continues: 'We do not intend to show how a certain *istorum* is transmitted into another, or how by means of a medical antidote, which the alchemists call elixir, diseases are healed and men's secrets revealed, or conversely their open knowledge is concealed, but rather to show that these stones are compounded from the elements and how each one is constituted in its own species. For we are not concerned to investigate the difference between a stone and a spirit or vapour and the substance and accidents of the body, which are matters which the alchemists investigate, calling a stone everything which does not evaporate in the fire, and at the same time body and substance, and that which does evaporate in the fire, like sulphur, quicksilver and the ingredients of the so-called stones of various colours (sc. which the alchemists make), they call spirit and vapour and accident. It belongs to another science to investigate these matters, which depend on very abstruse reasonings and methods.'

1 Steinschneider, *loc. cit.*, cf. Thorndike, II, 847, 853.

2 *De Mineralibus*, I, i (*Alberti Opera*, ed. Jammy, II, 210).

Albertus, he means, is not going to discuss alchemy. Two expressions are quite incomprehensible as they stand—Hermes Cuates, king of the Arabs, and *istorum*. The first is likely to be for Hermes *and* Evates or Evax, a reputed king of the Arabs, who is said to have written a work on precious stones to the address of the Emperor Nero.[1] Even so further clarification is necessary. As to *istorum*, which in the context should mean 'element' or 'principle,' it is natural to explain the word by some corruption of Arabic '*unṣur* or *iss* which have these meanings respectively. In the preface as a whole what is most striking is the attitude of Albertus to alchemy. Though he is not here concerned to deal with it and indeed may be thought to speak of it somewhat slightingly, it is clearly for him another science. Later on he remarks that alchemical operations are difficult and imperfect, especially in the manufacture of stones. This perhaps indicates scepticism of the utility of the pursuit, for as is well known, an important part of the efforts of the alchemists was directed precisely to the production of the 'philosopher's stone', by means of which transmutation of the baser metals into gold was to be effected. On the other hand, several works on alchemy are attributed to Albertus,[2] and he nowhere comes forward, it appears, with a clear denial of its possibility.[3]

As his practice was, after some general discussion of the subject Albertus proceeds to delimit it. 'We shall lay down,' he says, 'the names of the principal stones and their virtues, according to what we know either by experiment or from the writings of others. We shall not give all that is said about them, because it is of no advantage to science. For natural science is not simply the acceptance of what is reported, but enquiry into the causes of natural phenomena.' Some examples may show how Albertus applied what he has thus enunciated.

'The amethyst'[4], he says, 'is a very common gem, and is of a sort of purple colour and somewhat obscure transparency. Many differences are found in this species, but five grades of obscurity are

1 See below.
2 Thorndike, II, 569.
3 Cf., however, E.J. Holmyard, *Alchemy* (Pelican Series), 1957, 113.
4 Ed. Jammy, II, 228.

generally admitted. It is found in India. It is very suitable for cutting, because it is less hard than others. It is effective against drunkenness, according to Aaron, makes a person wakeful and restrains evil thoughts. It confers good intelligence in things knowable.' It is interesting to find that the following account of a stone mentioned also by Pliny is evidently regarded by Albertus, since he gives it, as of advantage to science. 'The *diacodus*[1] or *diadochus* is said to be a pale stone somewhat like the beryl. It is said to evoke phantoms to such a degree that the Magi make a principal use of it. Yet when applied to a corpse it loses its virtue, and it is held to have a horror of death. Such an account as can be given of these matters is to be found in the books of the Magi, Hermes, Ptolems and Thābit b. Qurrah, and it is not our present intention to discuss them.'

In another instance Albertus quotes his personal experience in confirmation of what he has found in his authorities. '*Draconitis*[2] is a stone extracted from the head of a dragon and is brought from the East, where there are great dragons. I myself saw in Suabia in Germany a stone upon which more than five hundred snakes had come together, in a meadow among mountains. When the owner passed that way, his men drew their swords and cut the snakes into many pieces. At the bottom of the pile lay a great snake cut in many pieces, under whose head was found a black stone shaped like a pyramid, not transparent, with a casing of white colour and containing a very beautiful representation of a snake. This stone was given me by the nobleman's wife, and I had it by me with the snake's head.' Again he tells us of 'the hyena stone, so called from the animal of that name, from whose eyes, when they turn into stone, it is extracted. The ancients Evax and Aaron say, moreover, that when placed under the tongue, it helps towards predicting the future by divination.[3]' This is quite a typical notice of Albertus. He accepts the existence of the 'hyena stone' and its origin from eyes of a hyena, but adds the rationalizing explanation 'when they turn into stone'. The further statement that it is useful for divination

1 Ed. Jammy, II, 230.
2 *Ibid.*
3 *Ibid.*, II, 232.

he adds on the authority of those who say so. He is able also to tell of a 'stone called *ophthalmus*,[1] so called from ophthalmia. Its colour is not named, perhaps because it is of many colours. It is said to help the wearer against all diseases of the eye. It is further said to blind the sight of bystanders, on which account it is called also "patron of thieves," for its wearers are rendered, so to speak, invisible.'

Some of these statements are bound to strike us as highly fantastic. The question of the sources of Albertus in his mineralogy is of considerable interest but by no means easy to answer. The sources actually named in the preface and elsewhere throughout the *De Mineralibus* present great difficulties, as is generally admitted. Evates or Evax has already been mentioned as a king of the Arabs who is said to have written a lapidary for the Emperor Nero. Such a work exists in Latin,[2] and was apparently used by one Marbod in the eleventh century as basis of his own lapidary written in verse.[3] Marbod's versified account of the amethyst, *diacodus*, hyena stone and *ophthalmus* tallies to a marked extent with the extracts just given from Albertus, and there can in fact be no doubt that Albertus made extensive use of the same material. Thorndike supposed that Evax and Aaron together=Marbod.[4] Evax and Aaron are sometimes named together in Albertus. Aaron cannot be identified with any known Arabic author, and would on this view be accounted for. But Aaron (which is a very suitable name, from the mediaeval point of view, for the author of a lapidary, because of Aaron's breast-plate, set with precious stones, in the Bible) is certainly not mentioned by Marbod and is quoted without Evax by Albertus.[5] These are facts which may seem to rule out Thorndike's equation. Ruska, on the other hand, thought that Aaron and Joseph, mentioned together, as we saw, in the preface, should be a pair of alchemical authorities who come in Greek works of alchemy viz. Reson and Josaphthia, *alias* Zosimus and his sister Theosebeia[6]. If this seems

[1] Ed. Jammy, II, 235.
[2] Bodleian MS. Hatton 100 (W.A. Greenhill, *op. cit.*, *sub v.* Evax).
[3] See Migne, *Patrologia Latina*, Vol. 171.
[4] *Op. cit.*, II, 430. He is followed by Sarton.
[5] E. g. above, on the amethyst.
[6] *Das Steinbuch Aristotelis*, 68, 70.

far-fetched, it well illustrates the difficulty of identifying these sources of Albertus. It may indeed be that Albertus knew both the prose Evax, the text of which, as already said, actually exists, and the versified Marbod, and referred to them sometimes together, sometimes separately, but the unfamiliar Marbod has been altered at some point to Aaron. As to the origin of the prose work, it is probably too early[1] to be Arabist, in the sense of an Arabic text put into Latin, nor do the names of the stones suggest an Arabic source. Neither does it appear to be classical, though some editions of Pliny mention Evax as dedicating his work to Nero or Tiberius. The best manuscripts omit this.[2] It looks like an addition to Pliny after the work of the so-called 'king of the Arabs' had become well known. Yet this cannot be said to be certain, and even if it is right, 'Joseph' is left entirely unaccounted for.[3]

Certainly Albertus had Arabist material for his *De Mineralibus.* Not only does he mention 'Hermes' and Avicenna repeatedly, but he refers also to the *Quadripartitus* of Ptolemy, an astrological work which had been translated by Plato of Tivoli a hundred years or more earlier (in 1138), giving it the Arabist title of *Alarba*, i.e. the Four (Treatises)[4]. Gilgil (Ibn Juljul) has already been mentioned. Yet no doubt on the whole the *De Mineralibus* is less obviously Arabist than either the *De Animalibus* or the work on botany, not having as its basis any major translation from the Arabic. By the same token, it has to be admitted that in the general impression which it makes, the *De Mineralibus* falls somewhat below the other two works. If we had time to cast our net a little more widely, we should have many more Arabist works to cite from Albertus, e.g. the *De Differentia Spiritus et Animae* of Qusṭā b. Lūqā,[5] translated into Latin by John Avendeath; the *De Intellectu*

1 Cf. Albertus *supra*, 'the ancients Evax and Aaron'. Here Aaron is doubtfully for Marbod, if the 11th century date for the latter (see above) is right.

2 Greenhill, *loc. cit.*

3 'Joseph', author of a dream-book, is referred to by Thorndike, II, 293, 294, n. 5.

4 Ed. Jammy, II 226. Cf. Steinschneider, *Die europaischen Ubersetz.* 65.

5 *Physica* I, 1, 4 (Jessen, *op. cit.*, xxxi). Cf. Steinschneider, *ibid.*, 43, and especially Manuel Alonso, 'Traducciones de Juan Hispano,' *Al-Andalus*, XVII (1952), 134ff.

of al-Kindī in the version of Gundisalvi, which Albertus for some reason found more convenient to use than the slightly later version of Gerard of Cremona;[1] the *De Intellectu* of al-Fārābī;[2] not to mention al-Ghazālī.[3] These, however, fall outside the limits which have already been laid down, and we cannot pursue the matter here.

We return to consider a question which has already been raised, viz., the attitude of Albertus to magic. It is noticeable that he is, so to say, at home with magic and magical practices in a way in which men of an earlier as well as a later age were not. Consider a passage in the *De Mineralibus* where he discusses images on gems and the alleged effects of these, and says specifically that this is a branch of necromancy.[4] It is a doctor of the Church who is speaking, in a book admittedly his. We may contrast the attitude to necromancy in the late classical period, or in the 17th century, when Dr. Dee and the medium Kelly are supposed to have been concerned with it. The expression here in the *De Mineralibus* must be regarded as free from all sinister associations.

Speaking on the subject of the virtues of plants, Albertus remarks[5]: 'It must be added that certain plants seem to have divine effects, which those who study magic attend to particularly. Thus betony is said to offer divination, vervain to induce love, and what is called woodpecker's herb (*herba meropis*) to open closed bars. There are many such things, which are written about in the books of incantations of the philosophers, Hermes and Qusṭā b. Lūqa, and in the books *De Physicis Ligaturis*.' The plantain has according to Albertus a virtue against the bite of a snake.[6] Such an operation, he says, we cannot attribute to simple qualities, but rather the active or passive quality has some one or more of these operations, by a heaven-sent virtue residing in the plant which operates thus. Some seem even to

1 Manuel Alonso, 'Traducciones del arcediacono Domingo Gundisalvo', *Al-Andalus*, XII (1947), 315.

2 *Ibid.*, 319.

3 Jessen, *op. cit.*, xxxiii.

4 *De Mineralibus*, III, i.

5 *De Veget.*, V, 118.

6 *Ibid.*, V, 116.

operate by simple suspension from the neck, like peony seeds, which are said to be efficacious against epilepsy, and there are many such operations. Ebony of the blackest shade has the best operation. Those who study incantation and the physical ligatures say that when fastened to a cradle, it will prevent a child being terrified by phantoms.[1] Another instance of a similar kind of magic is afforded by the wood of the medlar, which is sought for by enchanters to make therefrom the cudgels of professional fighters.[2]

That enchantment was real enough for Albertus seems clear when he tells us that the two halves of a hazel rod, split down the middle, will be attracted towards each other entirely *without* enchantment.[3] On the other hand, he uses the pharmaceutical notices of the *Canon* of Avicenna in rather a curious way, appropriating the strictly medical part without comment, but when magical precepts are given, as not uncommonly happens, attributing them to '*incantator*', the enchanter.[4] This usage, which misled Thorndike,[5] seems to indicate that Albertus distinguished clearly between magic and medicine. His attitude is illustrated also by a passage in the *De Animalibus*, where speaking about the hoopoe, he says that its members, and especially the brain, tongue and heart, are much sought after by enchanters'. This he has taken from his source, here Thomas of Cantimpre. He adds on his own account, 'But we are not here concerned with this, for to investigate such things belongs to another science'.[6] Magic and incantations exist in general for Albertus and are the legitimate object of science, but there is a note of hesitancy— 'it is said,' 'it seems,' 'they say'—about most of his particular instances. When a story is specially fantastic, he will go farther. Jorach says that the hyena changes its sex from time to time. But Jorach is frequently found to be a liar.[7] Thomas of Cantimpre has a fine story, taken over by Albertus, of how the enchanter, bound to a dragon, flies through the air for long distances. But sometimes

1 *De Veget.*, VI, 96.
2 *Ibid.*, VI, 133.
3 *Ibid.*, VI, 178.
4 *Ibid.*, 369, 431.
5 *Op. cit.*, II, 555-556.
6 *De Animalibus*, XXIII, 143.
7 *Ibid.*, XXII, 106.

when the animal tires, both fall into the sea and are drowned. Albertus notes : 'All these things are rather credited by rumour than actually experienced'.[1] Yet the surprising fact is that he gives the story. Enchanters exist practising their art. Dragons or at all events serpents exist (cf. the account above, where he begins with dragons in the East and ends with snakes in Germany). These things being so, he appears to say, it could just be that enchanters gain control of dragons, for example by beating an inflated skin or drum,[2] but this is not very likely.

We are concerned, however, not with the mental attitude of Albertus, but with his sources of information about magical practices. The question is whether he is dependent here, as elsewhere to an almost unlimited extent, on translations from Arabic. It may be said that here is an initial likelihood of this. The difficulty is to show in particular instances that it was so. As far as ligatures are concerned, it may be assumed that the work of Qustā b. Lūqā on this subject might explain a good deal, but it is not available. The question in any case goes much further than a single book, and we have to consider indirect as well as direct dependence.

An Arabic lapidary ascribed to Maslamah of Madrid[3] provides at least one unmistakable parallel if not with Albertus, at all events with his contemporary William of Auvergne, from whom, according to Lynn Thorndike,[4] Albertus borrowed the account of the property of a split hazel wand noted above. Whether this is so or not, William of Auvergne thought he knew that visions and revelations will be produced by the eye of an Indian tortoise and the heart of a hoopoe[5]. Albertus, as we saw, speaks of the heart of a hoopoe as sought for by enchanters. As to the eye of an Indian tortoise, it is one of the gems listed in the lapidary of Maslamah of Madrid, and in this case we can be practically certain that the source is Arabic. The whole passage in the lapidary is as follows.[6] 'The tortoise

[1] De Animalibus XXV, 28.
[2] *Loc. cit.*
[3] Bodleian MS. Marsh 452.
[4] *Op. cit.*, II, 362.
[5] Thorndike, II, 361.
[6] MS. Marsh 452, p. 122.

stone. This stone is in the eye of the Indian tortoise. It is a small stone, white in colour. It is extracted by being placed in a brazier of lighted coals. The tortoise is heated therein, not budging or moving from its place so long as the brazier is alight. The virtue of the stone is that when placed under the tongue, which has first been anointed with honey, the tongue utters knowledge of the future, as long as the stone remains under it.[1] The time during which the stone is to be employed thus is five days from the new moon, or at the beginning of the new moon.' This highly superstitious account involves sympathetic magic (honey upon tongue) as well as astrology. Shorn of these trimmings, the idea reappears in William of Auvergne, as above, and even in Albertus (jewels in the eyes of the tortoise, without mention of prophecy).[2] It seems virtually certain that this is not coincidence, and that the Arabic, even if not actually Maslamah (10th century A. D.), is more original.

Light is cast on the stories of magical practices in the writings of Albertus and his contemporaries by an Arabic MS. in the Cambridge University Library, described in the catalogue as the *Book of Talismans* of Ibn al-Waḥshīyah.[3] Ibn al-Waḥshīyah is well known as the author of a fantastic work on Babylonian or, as he called it, Nabataean agriculture which is unique of its kind in Arabic, and was studied last century by Chwolson. Ibn al-Waḥshīyah also wrote a curious but scientifically worthless account of ancient alphabets, especially the Egyptian hieroglyphics, edited with an English translation by Von Hammer as long ago as 1806. Ibn al-Waḥshīyah flourished about A.D. 900, and was studied, in a desultory fashion apparently, by the Muslims till much later. The older contemporary of Albertus, 'Abd al-Laṭīf al-Baghdādī, tells how when a young man in Baghdād, he met a Moor who was a student of alchemy and talismans. This man's favourite authors included Ibn al-Waḥshīyah, and although 'Abd al-Laṭīf did not like him he spent some time in trying to master the books which he recommended.[4] The Cambridge MS. is not, strictly speaking, in-

1 Cf. the hyena stone, above.
2 *De Anim.*, I, 143.
3 *Second Supplementary Handlist of Muhammadan MSS.*, No. 418 (Or. 1665).
4 Ibn abī Uṣaibi'ah, ed. Muller, II, 203-205.

spite of the catalogue and the title-page, Ibn al-Waḥshīyah's *Book of Talismans*, for it cites a work of the much later author, Ibn al-'Arabī.[1] But it contains a number of citations from Ibn al-Waḥshīyah, and gives a good general impression of what his *Book of Talismans* was like. The following magical 'experiments' are more or less exactly matched in the Latin writers of the age of Albertus.

(1) A lamp[2] which when you open your hand over it, goes out, and when you close your hand, the light returns. Take Indian nuts or chestnuts, and pound them. Then knead to a paste with water of camphor and spread upon your palm. Open it over or in front of the lamp, and its light will disappear. Close your hand, and the light will return. The same recipe is given by Lynn Thorndike[3] from a *Book of Fires for Burning Enemies* by Marcus Grecus.

(2) When you wish to make people think that they see you walking upon water[4] in a room or otherwise, take a green frog and kill it over a vessel of glass, taking care that none of the blood is lost. Then place in a suitable container, of which the mouth is stoppered, and heat till it is pulped. Then cast upon it a *dirham* of sulphur of Iraq, and leave till absorbed. Then cast upon it a *dirham* of red arsenic (*sandaracha*). When you know that it is absorbed, throw upon it a *dirham* of frankincense, then a *dirham* of sea-snail. Triturate and cast in certain aromatic roots, then heat till you know that all is pulped. Remove from the fire and pour into a glass vessel. When you wish to use it, cast it on a hot fire in whatever place you wish. You will see before you a sea, and the people will gird up their garments and plunge in after you. A similar 'experiment' 'When you wish to make people think that water like a sea is in your house, etc.'[5] is given later in the *Book of Talismans*. One or other of these is mentioned by Thorndike, as in a Latin collection entitled 'Experiments good and best'.[6]

1 Cambridge MS. Or. 1665, p. 107.

2 *Ibid.*, p. 73.

3 *Op. cit.*, II, 786.

4 MS. Or. 1665, p. 78.

5 *Ibid.*, p. 74.

6 *Op cit.*, II, 802,

(3) When you wish to show your room full of snakes and scorpions.[1] But let no one separate from his neighbour, because of the danger, and let no one turn against the creatures, lest he faint from the strength of the vision. This is given by Thorndike once from the *Liber Vaccae*,[2] and again from the *De Mirabilibus Mundi*[3], a work ascribed to Albertus but only doubtfully accepted as genuine by Thorndike.

Other 'experiments' in the Arabic *Book of Talismans* include the preparation of an egg which plays and dances in the warm room of a bath[4] (by inserting quicksilver in the egg); clearing the house of rats[5] (by burning the hoof of a mule); making the spectators imagine that they have asses' faces [6] causing the apparition of a monk clad in black robes with a crozier in his hand;[7] producing the illusion of a palm-tree with leaves of different colours.[8] All these are nearly enough matched by Thorndike from the Latin writers. It can scarcely be doubted that there is borrowing and on which side the borrowing took place.

Fantastic as much of this appears, it was evidently the stock-in-trade of a number of the Latin contemporaries of Albertus. Some trace of the same attitude of mind, in which literally anything may happen or indeed may be made to happen if one has the appropriate knowledge, has passed into the massive works of Albertus, which won the admiration of contemporaries and later generations. So far as the analysis has gone, in comprehending, as we must suppose he did, practically all the new knowledge, hermetic as well as rational, then available in Latin, Albertus appears to have been influenced occasionally by the former as well as the latter elements. To say this is not to detract from the greatness of his work, any more than criticism of the books ascribed to Maslamah of Madrid and

1 MS.Or. 1665, p. 77.

2 *Op. cit.*, II, 782.

3 *Ibid.*, II, 736.

4 MS. Or. 1665, p. 74.

5 *Ibid.*

6 *Ibid.*, p. 78.

7 *Ibid*, p. 75.

Ibn al-Waḥshīyah implies an adverse judgement of Arabic science. In both cases, what appears erroneous or trivial falls into place within a much greater whole, and the very quaintness of the ideas from our present-day stand-point, so far from causing tedium or disgust, serves to mirror aspects of the reality of things which cannot be exhausted even by a system as comprehensive as that of Albertus or by a science as extensive and various as Arabic.

IV. Peter of Abano and the School of Padua

The great Renaissance scholar Giovanni Pico della Mirandola, who unlike most of the humanists addicted himself, at least in part, to the study of Arabic, has the following severe stricture to pass on Peter of Padua, or Peter of Abano, as he is usually called. According to Pico,[1] 'That great dealer in the marvellous, Albumasar, writes that any man who prays to God at the conjunction of the moon with Jupiter in the head of the Dragon will obtain whatever he requests. Peter of Abano whose writings, as often as I read them, remind me of the saying of Heraclitus about much learning not conferring good sense, writes that he himself, at the hour mentioned, made a request for knowledge and from that time advanced greatly. I have not the leisure to decide how far this new Solomon did advance, but I believe certainly, that in any case he went no further than is attainable by human efforts.' The attitude of Pico della Mirandola to Arabism, in which he was genuinely interested, was not perhaps quite consistent. Here he gives what may be taken to represent the current Renaissance view, which is well expressed in another remark of his : 'Leave us, in Heaven's name, Pythagoras, Plato and Aristotle, and keep your Umar, your Alchabitius, your Ibn Ezra, your Abenragel.'[2] Not so Peter of Abano, for whom the Arabist authorities are even more indispensable than for Albertus. Peter of Abano's greatest work, entitled *Conciliator of the Differences of the Philosophers and particularly the Medicals*,[3] was written in 1303. The pages of the black-letter Gothic prints in which the work is normally to be read, bristle with Latinized Arabic (and occasionally Hebrew) names. Doubtless the author is to be regarded as one of the most typical of the Arabist school, when Arabism was still something of a novelty.

The facts of his life are involved in some obscurity, but it is clear that he was born at Abano, the locality near Padua from which he takes his name, towards the middle of the 13th century[4]. At this time

[1] *Astrol.*, IV, 8, cf. VII, 7.

[2] *Ibid.*, I, 1.

[3] *Conciliator Differentiarum Philosophorum et precipue Medicorum.* I have used an impression of 1524, belonging to St. Andrews University Library.

[4] Perhaps as Thorndike says in 1250 (*History of Magic etc.*, II, 876).

Padua was already the seat of a University (from 1222, when there was an influx of students from Bologna), but for the earlier part of his career Peter of Abano is associated particularly with Paris.[1] He appears to have travelled a great deal, as far afield as Constantinople. He evidently became something of a Greek scholar, and having obtained at the Byzantine capital a copy of the *Problems* of Aristotle, he is said to have translated it into Latin.[2] It is natural to think that in Constantinople he may have been in contact with such men as George Pacyhmeres, the commentator on Aristotle, and Maximus Planudes, the first Byzantine scholar who studied Latin literature, and who was responsible for a number of translations from Latin into Greek.[3] Before the *Conciliator* was written (1303), its author had been in Germany,[4] and he is said to have visited also Sardinia and Spain.[5]

More interesting perhaps from our point of view, he passed some time in Britain, though at what date and for what purpose remain quite obscure. Thorndike was somewhat sceptical as to references to England and Scotland in the *Conciliator*, but there is no doubt about them. Peter speaks in one place of having been troubled by a particular dream for more than two years, and mentions that while in England and Scotland, being replete with damp vapours and beer, for the space of almost a year he had relief[6]. It is evidently a kind of joke about the British climate. Elsewhere, commenting on the fact that the action of the poppy is not always the same, he adduces a curious argument. Wine in Egypt, a hot country, is, he alleges, cold, whereas in Scotland which is a cold country wine is hot. This is so because the heat of the

[1] Thorndike, II, 877.

[2] For the first time, according to Thorndike, *ibid.*, and Sarton, *History of Science* III, 1 (Baltimore, 1947), 493. But we have already seen Albertus using the *Problems* as a source of his *De Animalibus*. A translation of the *Problems* had in fact been made before Peter of Abano's time by Bartholomew of Messina (Sarton, *op. cit.*, II, 2, 829, cf. *Corpus Philosophorum Medii Aevi, Aristoteles Latinus, Pars Prior*, Rome, 1939, 86), who flourished at the court of Manfred, king of Naples and Sicily (1258-1266). A. Jourdain (*Recherches*, 75 ff.) cites a passage where Albertus appears to refer to this translation. Peter of Abano wrote a commentary on the *Problems* of Aristotle, which is concluded in one MS. : *Explicit expositio succincta compilationis problematum Aristotelis quam Petrus edidit Padubanensis et a nullo prius interpretante* (Venetian MS. S. Marco XII, 84, cited by Thorndike, *op. cit.*, II, 921), and his alleged translation of the *Problems* for the first time is evidently due to confusion.

[3] Cf. Basile Tatakis, *La philosophie byzantine* (Paris, 1949), 239 ff.

[4] *Conciliator*, 33a.

[5] Cf. Thorndike, II, 877.

[6] *Conciliator*, 209c.

mainland rarifies the pores of the earth, and permits the earth's internal heat to escape, while on the other hand in Scotland the pores of the earth remain obstructed by cold, and the internal heat, being unable to escape, renders the vines, and hence the wine, hot and strong, as is to be found at 'Thorisium'.[1] Since this is presumably a place in Scotland, the town of Thurso is perhaps meant,[2] which in the Middle Ages is said to have been a considerable port for the North Sea trade. Some place far to the North must be intended. Peter of Abano concludes the discussion by saying: 'And similarly for the poppy in Egypt and the like places, and in those places near the poles.'[3]

Some time after 1303 Peter of Abano left Paris and returned to Padua, where he is commonly said to have been the first professor of medicine in the University. That he here developed an important activity is plain from the pictorial representations which were made of him[4] and the references in later writers, especially during and after the Renaissance. He was unfortunate enough to draw upon himself the attention of the Inquisition, yet it is perhaps partly owing to this circumstance that he owed his later celebrity. Thorndike observes that the Italians and others in the 16th and 17th centuries misunderstood Peter of Abano 'as a precursor of their own period rather than as a final representative and product of a rich earlier period of culture'. It is in the latter sense that we have to regard him, and not exactly as 'a man most illustrious in genius, doctrine and merits in a rude and unhappy age'[6]—a typical later judgement.

Details of the Paduan professorship and the earlier part of his life, with a critical biography, are given by Thorndike. Here we need only consider one point, the connection of Peter of Abano with the symbolical paintings in fresco in the great hall of the Palazzo della Ragione at Padua. This hall, which is on the upper floor of the Palazzo, is reputed to have the largest roof unsupported by columns in Europe. Originally there were three roofs, spanning the three chambers into which the hall was at first divided, but in 1306 Fra Giovanni, an Augustinian friar, covered the whole with a single roof.[7] According to his

1 *Conciliator*, 250d.
2 I have been unable to find any Latin form for Thurso.
3 *Conciliator*, *ibid.*
4 Cf. Jac. Philippus Tomasinus, *Elogia* (1630), 21.
5 *Op. cit.*, II, 883.
6 Tomasinus, cited Thorndike, *ibid.*
7 H.F. Brown in *Enc. Brit.*, 11th ed., art. Padua.

16th century biographer Scardeone[1] and Nicolas Comnenus,[2] Peter of Abano designed more than four hundred pictures representing natural objects and various arts and operations, arranged under the twelve signs of the zodiac, the planets and the twelve months, which he then caused to be painted in the Palazzo, rendering it equal in magnificence to anything in Italy. These were afterwards destroyed in a fire and restored, according to this account, by the celebrated Giotto. The indication is that pictures of this kind had never been seen till Peter of Abano invented them. Visitors to masonic temples at the present day are often struck by the astronomical or rather astrological designs on the roof or elsewhere in the buildings. It may be that these derive ultimately from the designs at Padua, which appear to be the earliest of the kind in Europe. The impulse to depict such things as the signs of the zodiac and the planets is doubtless far older than the 14th century, but if this is their first appearance in the West, it seems evidently due to what Michael Scot had called the 'new astrology,' of which Peter of Abano remained throughout his life an ardent devotee and which was undoubtedly of Arabist origin.

We now come to consider Peter of Abano's main work, the once-famous *Conciliator Differentiarum Philosophorum et precipue Medicorum*. The purpose of the work was not, as has sometimes been thought, to reconcile the opinions of contemporary philosophers and doctors, for in the 13th and 14th centuries and even considerably later, as we shall have occasion to see, philosophy as an independent discipline scarcely existed, and there was no special class of professional philosophers, distinct from theologians, lawyers and doctors, to which special opinions might be attributed. Rather Peter of Abano, as he says, is giving in the *Conciliator* the substance of the questions in which he and his circle were interested, and which had formed the basis of 'classroom lectures and discussions for ten years previously'.[3] That is, the *Conciliator*, as its full name indicates, deals primarily with questions in dispute among the doctors themselves. It is a work of medical interest, in the first place, and also, in view of the wide field open to the medical man of this age, a work of general science.

The form of the *Conciliator* is rigidly scholastic. More than two hundred 'Differences' are laid down. To quote Thorndike, 'Each

[1] Bernardino Scardeone, *De antiquitate urbis Patavii et claris civibus* (Basle, 1560), 201-202.

[2] *Historia Gymnasii Patavini*, I, 279 (cited Fabricius, *Bibliotheca Lat. Mediae et Infimae Aetatis*, Florence, 1858, V, 230).

[3] Thorndike's phrase (*op. cit.*, II, 876).

problem is stated and any doubtful terminology is explained; the utterance of past authorities anent the question is reviewed; the true solution is then reached, and the reasons for it given; fourthly and finally, hostile objections are answered.'[1] The first ten Differences deal at length with such general questions as whether it is necessary for the medical man to know the other sciences; whether he must at the same time be a logician; whether medicine is theoretical; whether medicine is the most excellent of the arts; whether the human body is the subject of medicine; and whether the patient should be entrusted to one or more doctors. The 9th Difference is as to whether human nature is now weaker than it was in antiquity. The view is put forward that the world is now in last stage of its existence, and for human nature being weaker now than formerly. Mesue Junior and Serapion on the plant hellebore are quoted. At the present time, it is argued, white hellebore is intolerable and must be regarded as a deadly poison. Even black hellebore, which is less powerful in its effects, is now to be laid aside and a different remedy applied.

A wide range of medical and scientific interest is indicated by some of the other Differences.[2] Is the number of the elements four, or not? (Diff. 11); is the brain of hot or moist complexion? (Diff. 23); is the flesh or the heart the organ of touch? (Diff. 42); is life possible below the equator? (Diff. 67); is there a mean between health and sickness (Diff. 72); is a small head a better sign (sc. of intelligence) than a large one? (Diff. 79). The last remind us of the interest which men of this age had in the pseudo-science of physiognomy. Michael Scot's book on the subject, forming the third part of his trilogy already referred to, was apparently the most popular of all his works.[3] Peter of Abano himself wrote a *Liber Compilationis Phisionomiae*, and dedicated it to the captain-general of Mantua. Difference 80 debates whether the arteries are dilated and contracted when the heart is. A supplement to Difference 103 enquires: is death more likely to occur by day or night? The later Differences are largely concerned with matters of medical practice and personal hygiene. Should one eat once, twice or several times a day? (Diff. 120); should one sleep on the right or left side? (Diff. 123); should treatment begin with strong or weak medicine? (Diff. 154); can fever coincide with apoplexy? (Diff. 182, supplement); is a narcotic good for colic? (Diff. 204); is blood-letting from the left hand a proper treatment for gout in the right foot.

[1] Thorndike, II, 885.
[2] Cf. Thorndike, II, 886-887.
[3] See p. 54.

(Diff. 206). These titles by themselves, with their antiquated preconceptions, scarcely do justice to the learning and experience amassed in the text.

We are here specially concerned, as before, with the sources from which Peter of Abano draws. As already said, he makes use of Arabist translations to a very marked extent. He is of course perfectly conscious of what he is doing and the nature of the sources used. More than once he speaks of the Arabic translation of the Greek, and sometimes he permits himself criticism of what he calls the mendosity or defectiveness of the Arabic translation.[1] He knows about the new direction in medical studies which had by this time set in, for he speaks of the Greeks and the Arabs to whom the Latins now adhere,[2] and in another place of the 'modern school.'[3] Again, he contrasts the main groups of the new authorities, remarking that Galen and the Greeks seem to be fonder of phlebotomy than the Arabs.[4] It has probably to be allowed that for the most part even his Greek authorities come by way of Arabic. The translation of Aristotle's *Problems* direct from Greek to Latin, which Peter himself is said to have made, is evidently a special case.[5] The works of Hippocrates and Galen, on the other hand, of Nicolaus Peripateticus[6] (Nicholas of Damascus), and other Greek authors, had been rendered into Latin by Constantine Africanus, Gerard of Cremona, etc., from Arabic. Like other medicals of this age and later, indeed at all times, Peter of Abano was evidently content to use existing translations where he could.

Undoubtedly the extent to which Peter of Abano cites Arabist works is very impressive. Among Arabic philosophers he has references to al-Kindī,[7] al-Fārābī, Avicenna, al-Ghazālī[8] and Averroes. Of works specially named he refers to the *De Ortu Scientiarum* of

1 *Conciliator*, 76b.
2 Ibid., 148b.
3 'Moderni autem in hoc quaesito cum prolixitate distant.'
4 *Conciliator*, 218b.
5 See p. 84, n. 2.
6 E. g. *Conciliator*, 18d.
7 *Ibid.*, 192a *et seq.*
8 *Ibid.*, 16b, 21a, 21b.

al-Fārābī,[1] which had been translated by Dominicus Gundisalvi[2] and a *Compendium* or *Paraphrase* of Aristotle's *Rhetoric* also by al-Fārāb [3] which had been translated by Hermann Alemannus. Of Avicenna a number of works are mentioned in the *Conciliator* by name: the *Abbreviatio*,[4] translated by Michael Scot; the *De Anima*[5], translated by John Avendeath [6]; the *Metaphysics*,[7] translated by Gundisalvi ; [8] and the *De Coelo et Mundo*,[9] translated by John Avendeath.[10] Of Averroes the *De Substantia Orbis*,[11] translated by Michael Scot, is mentioned by name. Peter of Abano is in fact *au fait* with the range of Arabic philosophy. The only great name which he fails to quote is that of Avempace, for the reason doubtless that Avempace seems not to have passed into Latin.

Of Arabic medical writers, beginning with Mesue Senior [12] (Yaḥyā b, Māsawaih or John Mesue) and Johannitius,[13] *i.e.* Ḥunain b. Isḥāq, whose medical Introduction under the title *Eisagoge* was very early translated into Latin, as we saw, Peter of Abano has practically all the authors of importance: Isaac Israeli, *De Elementis*,[14] trans-

1 *Conciliator*, 13c.

2 M. Alonso, 'Traducciones del arcediano Domingo Gundisalvo', *Al-Andalus*, XII (1947), 298. There the work is called *Liber de Scientiis*, which appears to have been Gerard of Gremona's title for his own translation (*ibid.*, 300). The original title is *K. iḥṣā' al-'ulūm*, i.e. Enumeration of the Sciences. The MS. published by Gul. Camerarius (Paris, 1638) containing Gundisalvi's translation was entitled *Compendium Omnium Scientiarum* (A Gonzalez Palencia. *Al-Fārābī, Catalogo de las cientias*, ed. 2, Madrid-Granada, 1953,85). Steinchneider (*Europ. Ubersetz.* 44) mentions the title *De Ortu Scientarium*, but, as the *incipit* shows, the work in question is not either of the translations of the *K. iḥṣā' al-'ulūm*. It is the more or less original work of Gundisalvi, usually called *De Divisione Scientiarum* (see *Beitrage zur Geschichte der Philosop hie des Mittelalters*, IV, 2-3, 1903).

3 'Alpharabius in didascalicis sup. Ari. rhetorica.'

4 *Conciliator*, 205a.

5 *Ibid.*, 4a, 29b.

6 M. Alonso, 'Traducciones del arabe al latin por Juan Hispano (Ibn Dāwūd)', *Al-Andalus*, XVII (1952), 145.

7 *Conciliator*, 6b, 8a.

8 M. Alonso, *Al-Andalus*, XII (1947), 333.

9 *Conciliator*, 17c.

10 i.e. the work called by the Latins the *De Coelo et Mundo* of Avicenna was translated by John Avendeath (M. Alonso, XVII, 1952, 140 ff.) Cf. M. Alonso, 'Traducciones de Juan Gonzalez de Burgos y Salomon,' *Al-Andalus*, XIV (1949), 312ff.; the same, 'Hunayn traducido al latin,' *Al-Andalus*, XVI (1951), 37ff.

11 *Conciliator*, 13c.

12 *Ibid.*, 8d, 9a, 195a (Damascenus in aph.), cf. Brockelmann, *GAL.*, I, 232).

13 *Ibid.*, 129c, 129d, 130d.

14 *Ibid.*, 17a.

lated by Gerard of Cremona, and *De Febribus*,[1] translated by Constantine Africanus; Rhazes, repeatedly cited, by name for his *Liber Almansoris* , dedicated originally to the Sāmānid al-Manṣūr and rendered into Latin by Gerard of Cremona, and for the *Liber Divisionum*,[2] translated twice in the earlier days of Arabism, by Constantine Africanus and again by Gerard of Cremona; Serapion, i.e. Yāḥyā b Sarāfiyūn, for the *Breviarium*,[3] Arabic *Kit b al-kunn ish*, which had been translated by Gerard of Cremona; Haly Abbas,[5] *i.e.* 'Alī b. al-'Abbās, who was the personal physician of the Buwaihid 'Aḍud ad-Daulah, and dedicated to him his celebrated *Kitāb al-malakī* (Royal Book), known in Latin in the version of Stephen of Pisa (or Antioch) as *Liber Regius* or *Regalis.* Peter of Abano also cites a work *De Definitionibus* of Isḥāq b. 'Imrān,[6] the translator of which was Constantine Africanus, and the *Expositio Galeni Tegni* (*i.e.* the *Ars Parva* of Galen) by 'Al b. Riḍwān,[7] a well-known Egyptian physician of the 11th century, which had been translated by Gerard of Cremona. Avicenna's *Canon of Medicine* (*Qānūn fī'ṭ-ṭibb*) was extensively used by Peter of Abano, as were also the medical works of Avenzoar and Averroes. Avenzoar or, to give him his Arabic name, Abū Marwān 'Abd al-Malik b. Zuhr, came of a celebrated medical family, was in the service of the Almoravid dynasty and died in Seville in 557/1162.[8] His best-known work, in Latin *Theisir*, corresponding to the first part of the Arabic title (*Taisīr fi'l-mudāwāt wa', t-tadbīr*, meaning something like 'Facilitation in Medical Cures and Treatment'[9] is cited by name in the *Conciliator.*[10] Averroes, with characteristic mediaeval catholicity of interest, was physician as well as jurist and philosopher. Peter of Abano refers a number of times to his most important medical work the so-called *Colliget*,[11] *i.e. Kulliyāt*, 'Universal Principles', which had been rendered into Latin, actually

[1] *Conciliator* 214c.
[2] *Ibid.*, 181a, 191b, 200a, 227b.
[3] *Ibid.*, 252b, cf. 112a.
[4] *Ibid.*, 13d.
[5] *Ibid.*, 2a, 6d, 129a.
[6] *Ibid.*, 4b.
[7] *Ibid.*, 2a, 2c,
[8] For him see G. Colin, *Avenzoar, sa vie et et ses oeuvres, Publications dela Faculte des Lettres d'Alger*, T. 44, Paris, 1911.
[9] Or as Colin says (*op. cit.*, 47), therapeutics and dietetic.
[10] *Conciliator*, 75b, 115a, 220d.
[11] *Ibid.*, 9c, cf. 6d. Averroes is often referred to by name, or as 'Come', Commentator (*ibid.*, 13a, 14a, 129b).

at Padua, in 1255 by the Jew Bonacosa.[1] Renan for some reason says that Peter of Abano does not cite the *Colliget*[2] but this is not the case.

Further, the *Conciliator* abounds with references to most of the principal Arabic astronomers and astrologers. Mesahalach or Masahalach[3] is for Māshā'llāh of al-Başrah, whose *Epistola* is cited, probably the *Epistola de Rebus Eclipsis Lunae et Solis*, translated into Latin by John of Seville[4]. Omar Tiberias in the text[5] is for 'Umar b. Farrūkhān aṭ-Ṭabarī (*i.e.* from the district of Ṭabaristān, south of the Caspian) another early Arabic astronomer, who flourished under the Caliph Ma'mūn. Alfraganus, repeatedly cited,[6] is for al-Farghānī, whose name points to a connection with distant Farghānah in Turkestan, though the circumstances of this scholar's life are not known. Several of his works had by this time been translated into Latin by various hands. Albumasar is frequently cited[7] sometimes as Geofar, for his full name was Abū Ma'shar Ja'far b. Muḥammad of Balkh, or rather perhaps from a family deriving from that place. The *Introductorium* of Albumasar had been put into Latin by John of Seville[8]. I have not noted that Peter of Abano refers to Albategnius (al-Battānī), but he has Alchabitius[9] (al-Qabīṣī) and Abenragel[10] ('Alī b. abī'r-Rijāl), whose full name is deformed in the text as 'Haly heben ragel'. Further he mentions al-Biṭrūjī[11] (whose work *On the Sphere* was translated by Michael Scot), though not perhaps Ibn az-Zarqālah. 'Thabith' and 'Chorath'[12] are evidently intended to represent Thābit b. Qurrah, here cited presumably as an astronomer. Among Arabic alchemists Peter of Abano refers to Jābir.[13]

All this implies an impact made on the scientific mind of the age, in the person of one of its leading men, by Arabism, which it would be

1 Steinschneider, *Europ. Ubersetz.*, 8.
2 *Averroes*, ed. 4 (Paris, 1893), 217.
3 *Conciliator*, 22b, 128b.
4 M. Alonso, 'Juan Sevillano, sus obras proprias y sus traducciones,' *Al-Andalus*, XVIII (1953), 34.
5 *Conciliator*, 69b.
6 *Ibid.*, 16a, 151c,
7 *Ibid.*, 2b, 5b, 14c, 129b.
8 M. Alonso, *Al-Andalus*, XVIII (1953), 40.
9 *Conciliator*, 129b.
10 *Ibid.*, 14d.
11 *Ibid.*, 13b, 16a, 18c.
12 *Ibid.*, 15c.
13 *Ibid.*, 204.

difficult to exaggerate. In Peter of Abano mediaeval Arabism perhaps reaches its highest level. More systematic than Michael Scot, whom otherwise he resembles rather closely, more Arabist than Albertus, Peter of Abano creates not indeed a complete Arabist system, but at least an Arabist approach and method. The measure of his success is the length of time during which the same Arabist authorities continued to influence, indeed it is perhaps not too much to say, to dominate higher study in northern Italy and especially at Padua.

Before attempting to follow this later development, it seems worth while to say something of another author used by Peter of Abano and not mentioned among the names already given. In his pharmacology, entitled *De Venenis*, Peter of Abano refers to one Dorachius the astrologer.[1] Dorachius is evidently a corruption side by side with the commoner Doronius, also Dordonius, Doromus,[2] etc., of the name of Dorotheus of Sidon, a classical author quoted by Manilius. Dorotheus composed astrological poems (*Apotelesmata*),[3] identifiable with or including the *Pentateuchos*[4] a work written originally in Greek verse. According to al-Qifṭī,[5] the *Pentateuchos* in five books, with a sixth and seventh on astrological questions and nativities respectively,[6] was translated and commented on by 'Umar b. Farrukhān. A Latin translation of the *De Nativitatibus et Interrogationibus* of 'Umar b. Farrukhān was made by John of Seville.[7] The consonance of title with the sixth and seventh book just mentioned is noticeable, and it is perhaps to this translation that Peter of Abano refers. On the other hand, he speaks, as we saw, of Omar Tiberias as well as Dorachius, and 'Umar b. Farrukhān was known to others of the Latins, e.g. Pico della Mirandola, as Aomar.[8]

1 *Conciliator*, 257d.
2 Cf., Steinschneider, 'Uber die Mondstationen (Naxatra) und das Buch Arcandam,' *ZDMG.*, XVIII (1864), 156, A. 43.
3 See the Classical dictionaries s. v. Dorotheus.
4 Wenrich, *De Auctorum Graecorum Versionibus* etc., 292. There are more recent studies of Dorotheus and the *Pentateuchos* by V. Stegemann in *Corpus Codicum Astrologicorum Graecorum*, VI, 91-113 and *Astrologie u. Universal-Geschichte*, Leipzig, 1930, 12-17 (cited Francis J. Carmody, *Arabic Astronomical Sciences in Latin Translation*, University of California Press, 1956, 70).
5 Ed. Lippert, 184.
6 Together with what al-Qifṭī calls a sixteenth book (?) but this seems intended as the title of a separate work. The same notice is already in the *Fihrist*, ed. Flugel, 268.
7 M. Alonso, *Al-Andalus*, XVIII (1953), 41ff.
8 So in the original of the passage referred to p. 83, n. 2.

It looks therefore as if other productions of 'Umar b. Farrūkhān were at one time available, as well as the *De Nativitatibus et Interrogationibus*. A translation of the '*Book of Dorotheus*' by 'Umar b. Farrūkhān is reported to exist in a Turkish library,[1] and if this should turn out to contain the *Pentateuchos*, it would be a welcome addition to our knowledge of a Greek author whose work in the original has practically disappeared.

To return from this digression, it is no doubt right with Renan to regard Peter of Abano as the real founder of the Paduan school.[2] This is certainly true of medicine, where Arabism remained standard, with Avicenna as the leading authority. At Padua also philosophy came to be strongly Averroist, i.e. the teaching of philosophy was based on Aristotle, interpreted in the light of the commentaries of Averroes. The first exponent of this appears to have been Gaetano of Teano[3] (1387-1465), but doubtless the high prestige already gained by Arabist works in the University contributed to the adoption of Averroism as the system of philosophy normally taught.

The question of magic at Padua has also to be considered. It is repeatedly asserted that Padua was a school of magic and that such and such named individuals had studied there. We have already noticed the legend of a school of magic at Salamanca in Spain. It is possible that the origin of the stories is in both cases the same and due to the kind of instruction given at the two centres. We may readily enough conceive that reports of Arabic authors with strange-sounding names being commented upon in the schools of Padua and Salamanca should give rise, especially among the uneducated, to the belief that magic was taught there. The actual contents of some of the works to which we have referred might well give colour to the view. It is of course unthinkable that the arts of magic, or what passed as magic, were openly professed at any school in Europe in the Middle Ages or later. To that extent the stories about Padua and Salamanca may safely be set aside. But the matter is perhaps sufficiently remarkable to call for a little further investigation.

The Salamancan school was founded in the 13th century, and rapidly became one of the leading Universities in Europe. It is said to have been named at the Council of Vienne in 1311 as one of the places where means for studying the Oriental languages were to be

1 Brockelmann, *GAL.*, ed. 2, 1. 249.
2 Cf. H. Rashdail, *Universities of Europe*, I, 265, n. 2.
3 Rashdall, *loc. cit.*. R. C. Christie, *Selected Essays* (London, 1902), 130.

created.[1] A reader in Hebrew is actually mentioned at Salamanca a hundred years later, who was also responsible for instruction in Chaldaean and Arabic.[2] But this is quite a different thing from an Arabist tradition, in the sense in which we have been considering it, and in the sense in which there was an Arabist tradition elsewhere, e.g. at Padua. It has been as asserted indeed that the doctors at Salamanca translated the Arabic works of Avicenna and Averroes and the commentaries of Galen.[3] But there is no evidence for the statement, and the present writer knows of no single fact which makes it in any way likely. There was no Muslim school in Salamanca before the Reconquest. This part of Spain was a battle-ground between the two sides till the 11th century when the Arabs were finally driven out. That is to say, there was no continuous tradition of culture, as at Toledo. In the later stages of the Reconquest we cannot expect to find much sympathy in Spain for Arabism. It does not appear that Arabist texts were ever studied in the Universities. By the 16th century the attitude in Spain to the Arabs and Arabic had so hardened that the scholar Clenardus, who came from the Low Countries specially for the purpose of studying Arabic, could scarcely find a teacher. At Salamanca Fernando Nunez, a distinguished man, said to Clenardus: 'What concern have you with this barbarous language, Arabic? It is quite sufficient to know Latin and Greek. In my youth I was as foolish as you, and not content with adding Hebrew to the other two languages, I also took up Arabic. But I have long since given up these two last, and devote myself entirely to Greek. Let me advise you to do the same'.[4] This was in the year 1532.

The case of Padua is quite different. Here undoubtedly was a strongly rooted Arabist tradition in both medicine and philosophy. Not only so, but definite people are stated to have studied magic in Padua, e.g. that Earl of Gowrie involved at the end of the 16th century in the mysterious Gowrie Conspiracy, and in the next century James Carnegie, the 'Black Earl' of Southesk,[5] who was one of Montrose's

[1] In both the lists that are given—Rome, Bologna, Paris Oxford and Salamanca (G. von Grunebaum, *Mediaeval Islam*, Chicago, 1946, 51, cf. H. Rashdall, *op. cit.*, 1, 88), and Paris, Louvain and Salamanca (*Legacy of Islam*, Oxford, 1931, 65, and Phillip K. Hitti, *History of the Arabs*, ed. 6, 663).

[2] Rashdall, *op. cit.*, I, 88, n. 5.

[3] By the author of the article 'Salamanque' in Larousse, *Grand Dictionaire Universel*.

[4] See R. C. Christie, *op. cit.*, 106.

[5] Sir J. Balfour Paul, *Scots Peerage*, III, 69.

captains. Can we speak of an association of ideas between magic and the attested Arabism of Padua? Though this seems on the face of it plausible, as already indicated, in view of the available evidence it is not very likely. An official statement about the Gowrie conspiracy was published in September, 1600. The attempt on the King had been made in the house of the Earl of Gowrie at Perth. According to the official statement,[1] after his escape, 'His Majestie having, before his parting out of that town, caused to search the sayde Earle of Gowrie's pockets, in case any letters that might further the discovery of that conspiracy might be found therein. But nothing was found in them, but a little close parchment bag, full of magical characters and words of enchantment, etc. Gowrie's pedagogue or tutor, Mr. William Rynd, deponed before the Privy Council in regard to these characters that he saw them first at Padua, on returning from a short visit to Venice, and that having asked where they came from, was told by Gowrie that he had copied them himself. Thereafter, according to Rynd, the Earl 'would never be content to want the characters off himselfe from the first time that the deponer sawe them in Padua', till the hour of his death.[2] A deposition was also taken by the Privy Council from a certain James Weimys, which added further details about Gowrie's interest in magic while in Padua. The Earl claimed to have acquired knowledge of the Qabbalah, by which he said that he could charm snakes and work other miracles.[3] These particulars naturally got further publicity, and were mentioned in sermons of the time.[4]

But the connexion of the black arts, knowledge of which has frequently been charged against the objects of popular detestation[5], with Padua seems to be fortuitous. Gowrie, according to Weimys, said that he had learned the *Hebrew* word with which to charm a snake from a 'cabbalist of the Jewes' and that he had spoken with another man who had the reputation of being a 'nigromancer.' Assuming that these encounters took place at Padua, which is nowhere stated explicitly, we certainly find nothing here to point to a connexion with Arabist studies at the University. If the Earl of Gowrie gave attention to magical matters at Padua, the activity was strictly, it appears, extra-mural.

1 Lord Hailes, *Annals of Scotland*, (Edinburgh, 1819), III, 375.
2 *Ibid.*, III, 383ff.
3 *Ibid.*, III, 381ff.
4 *Ibid.*, III, 377,n.
5 Cf. Sir Walter Scott, *Minstrelsy*, Part IV (note on John Leyden's poem 'Lord Soulis').

Yet about this time wizardry and Padua were associated in the public mind. A little later, in the 17th century, the magical reputation of the 'Black Earl' of Southesk was doubtless due to personal unpopularity and some more or less chance association. To revert to the Earl of Gowrie, a contemporary account of the conspiracy claims to give the pretext used to separate the King from his attendants. 'The house of Gowrie were all of them much addicted to chemistry, and these more, to the practice, often publishing, as such professors usually do, more rare experiments than ever could be performed, wherein the King, a general scholar, had little faith. But to infuse more credit to the practice, Alexander Ruthven, the second brother, takes this occasion, and withall conspires with Gowrie to assassinate the King, and taking opportunity in his hunting not far from his house St. Johnston, invites the King to be an eye-witness of his productions. In their way, Sir Thomas Erskine, after Lord Kelly, overtakes them and others, demanding the Duke of Lenox, then present, why Alexander had engrossed the King's ear, to carry him from his sports? Peace, man, said the Duke, weis (until) all be turned into gold .... And thus was the King brought to guest'.[1] There is no means of knowing if this is an approximately true account of what took place, but it would make sense of part of the mystery. There is no report that Gowrie had studied alchemy while at Padua.

It is time to speak of what actually was taught at Padua. The Arabist legacy appears to have been two-fold, as we saw, relating to medicine and philosophy. To take philosophy first, it may be summed up in a single name—Averroes. Averroism, which had become fashionable in Paris during the 13th century, had soon ceased to be influential there. But in North Italy and especially at Padua a rather special type of scholasticism gradually developed, in which Averroes rather than Aristotle was the great authority.[2] In the latter half of the 15th century, at Padua, Averroism was practically absolute.[3] It is remarkable also to find here philosophy associated with medicine rather than theology, and taught not by ecclesiastics but by laymen holding medical degrees. The unusual arrangement perhaps illustrates the point already made, that philosophy had scarcely as yet a recognised place as an independent discipline.[4] It is in line with the attitude of Peter of Abano (whose influence

1 Hailes, *op. cit.*, III, 346, n.
2 Cf. Rashdall, *op. cit.*, I, 262f.
3 Christie, *op. cit.*, 130.
4 Cf. J. A. Symonds, *Renaissance in Italy*, (London, 1898), V, 401.

evidently continued strong at Padua), for whom philosophers and medicals were practically the same class. In some ways—more nearly perhaps than other contemporary men of learning—these lay philosophers teaching at Padua are the prototypes of the modern professional philosopher.

Nicoleto Vernias was professor of philosophy at Padua from 1471 to 1499.[1] In 1483 he published a Latin version of Aristotle's *Ethics*, with the commentary of Averroes, and other works of Aristotle in Latin (including the *Politics*), in which he styled himself 'Professor of the Liberal Arts and of Medicine, at present reading in the University of Padua'.[2] The version of the *Ethics* thus sponsored was that of Hermann Alemannus in the 13th century. Nicoleto openly professed and taught the opinion of Averroes that the individual soul emanates from and is absorbed again into the soul of the universe. This was perhaps held by him and presented as merely a philosophical theory.[3] Its heretical character, as practically denying the immortality of the soul is sufficiently obvious. The doctrine is, however, respectable enough to have a technical name (panpsychism), and it has been supposed that Averroes derived it from his great predecessor Avempace.[4] Whether it was held by any earlier thinker seems uncertain, but it was now for a time to have great popularity at the school of Padua.

Nicoleto's pupil Agostino Nifo (Niphus) put forward the same view in a work *De Intellectu et Daemonibus*, which caused considerable controversy.[5] Nifo lectured with success at Padua and elsewhere. He taught a modified Averroism, in which the points at which Averroes differed from orthodox Aristotelian doctrine were smoothed over.[6]

Alessandro Achillini represented the same modified Averroism.[7] He is perhaps principally remembered for his debate with Pomponazzi who like himself was for a time a teacher of philosophy at Padua. Pomponazzi began his career by taking a medical degree[8] and eventually became 'Professor of Natural and Moral Philosophy' at Bologna.[9] He was a man of more original stamp than others of the

1 Christie, *op. cit.*, 131.
2 Panzer, *Annales Typographici*, III, 191-192. Renan (*Averroes*, 86) mentions an edition of Aristotle and Averroes in 1483 and 1484 by Andrea of Asolo, who was no doubt the printer.
3 Christie, *ibid.*
4 Lacy O'Leary, *Arabic Thought and its Place in History*, 257.
5 Christie, *ibid.*
6 *Ibid.*, 144.
7 *Ibid.*, 134.
8 *Ibid.*, 130.
9 Symonds, *op. cit.*, V, 402.

North Italian philosophers, and, breaking away from the regulation Averroism, claimed to adopt the interpretation of Aristotle represented by Alexander of Aphrodisias. He rejected the unity of souls and collective immortality, maintaining that, according to Aristotle, the soul was mortal. This precipitated a controversy, in which Nifo and others took part against Pomponazzi.[1] Popular interest was roused to an extraordinary pitch. A follower of Pomponazzi, invited to lecture at Pisa, opened his course with Aristotle's *Meteora*. But the whole assembly, consisting of students and people of the town, interrupted him with the cry, '*Quid de anima*?' 'Tell us about the soul!'[2] Both views of the soul's nature were condemned by the Lateran Council in 1512.[3]

Another representative of the school was Marco Antonio Zimara, whose name has already been mentioned. He died in 1552. Zimara was a diligent student of Averroes, and attempted to mediate between his views and those of Aristotle.[4] But like most if not indeed all of the later Averroists Zimara seems to have had little interest in the mere Arabic text of his author, preferring the Latin versions, sanctioned now by centuries of use.[5] Here the Averroists and the scholastics in general present a marked contrast to their rivals, the humanists, who above all things wanted to get at the Greek texts and read them. In the course of the 16th century Averroism declined in importance at Padua and elsewhere. The characteristic philosophical teaching of the Paduan school seems, however, to have disappeared finally rather owing to the increasing orthodoxy of the Italians than to the competition of humanism.

The above-mentioned philosophers were all influenced positively or negatively by Averroes. The fate of Averroes is indeed singular. Almost entirely disregarded until the most recent times by his fellow-countrymen and co-religionists, his writings became as it were naturalised during the 14th and 15th centuries of our era in what might have seemed the alien soil of Italy, and here Averroism flourished as nowhere else, before or since. A new and more potent intellectual movement—the Renaissance—took place, which should at

1 Symonds, V, 403.

2 *Ibid.*, V, 419.

3 Christie, *op. cit.*, 133.

4 *Enc. Brit.*, 11th ed., art. Arabian Philosophy (by William Wallace and G. W. Thatcher).

5 See an example in Chapter III, p. 69.

once have outmoded the Averroism of Padua. Nothing of the kind happened. The school of Padua, supported by the republic of Venice, continued to flourish. It is a tribute no doubt to the merits of the philosophy of Averroes, but certainly also to the conservatism of the Venetians, who appear to have been determined that no mere matter of literary fashion, in this case the rediscovery of the classics of Greece and Rome, should be allowed to interfere with the educational system to which they were accustomed.

In the medical schools of Padua Avicenna held the same high place as Averroes in philosophy, but the acolytes were perhaps less single-minded in their devotion. By the end of the 15th century, if not earlier, foreigners were being attracted to the school. The English humanist Linacre took the degree of doctor of medicine at Padua after 1484, and about the same time was studying Greek with Politian at Florence.[1] At the close of the century a doctor (i.e. professor) of medicine at Padua received 1000 ducats (which was also the stipend of an eminent jurist), together with the right of private practice.[2] The humanists seem to have been much less well paid. In 1453 one Lauro Quirino, who professed rhetoric at Padua, was paid only 40 ducats yearly[3]. Dr. John Caius, who virtually refounded Gonville and Caius College, Cambridge, was a student and perhaps also a professor at Padua. He took his degree there in 1541[4]. Benefiting by her close association with Venice, Padua had become the leading scientific school in Italy. She had outstripped Bologna, and Paduan charges for a degree were higher than at Bologna.[5] The celebrated Vesalius lectured on anatomy in Padua from 1536. He of course worked with the text-books available at the time, and is said to have made a translation, presumably a paraphrase, of the ten books of Rhazes *Ad Almansorem*.[6]

The works of Vesalius present numerous Arabisms, which by his time tend to appear in even stranger guise than they did earlier. An alarming treatment for catarrh, prescribed by Mesue Junior, consisted

1 *Enc. Brit.*, art. Thomas Linacre.
2 Symonds, *op. cit.*, II, 88.
3 *Ibid.*, II, 89.
4 *Enc. Brit.*, art. John Caius.
5 Rashdall, *op. cit.*, I, 228, n. 1.
6 Joseph Hyrtl, *Des Arabische und Hebraische in der Anatomie* (Vienna, 1879), xxxix.

in cauterization and the application of corrosives to a part of the forehead called in the Latin text *zubendech*.[1] This word already presents difficulties of interpretation. It is supposed to be Persian, acclimatised in Arabic, *zau bandaq* or rather *dhū bandgāh*, 'the joining of the suture,' in modern anatomy *Locus fonticuli frontalis*. But in Vesalius we find with reference to this passage the expression *zeudech Mesuae*,[2] where the word *zeudech* is completely corrupt. How the Arabist doctors of the Paduan school were able in practice to apply with success, as they apparently did, a theory containing such highly obscure and artificial expressions is not easy to see. It was only in comparatively rare cases that these men were in a position to confront their Arabist Latin texts with the original Arabic, and even if they knew Arabic, they might well continue in difficulties.

There is one group of Arabist doctors, of Transalpine origin, like Vesalius himself, and connected with Padua, whose Oriental acquirements were celebrated,[3] and with whom this account of Arabic science in the West may fittingly close.[4] These men were distinguished doctors in their day and competent Arabists. The oldest of them, Plemp, or Plempius as he is often called, was born in 1601 in Amsterdam, studied at Ghent and Louvain, then passed to Leiden and finally Padua, where he worked under Spigelius. He graduated doctor of medicine at Bologna. Returning to Holland, he enagaged in private practice in his native city. Later he was called to Louvain as professor of medicine, and remained there, active and successful, till his death in 1677. Plempius as professor at Louvain published (1658) a Latin translation of Avicenna's *Canon of Medicine*, which is later than any of the numerous Juntine editions.

Another of the group, Deusing, also a Dutchman (1612-1666), become rector of the University of Groningen, and published in 1649 a translation of the versified work, scarcely a poem, of Avicenna on medicine, the so-called *Canticum*, together with the *Medical Aphorisms* of John Mesue (Mesue Senior), which had been one of the first Arabic medical works to be translated (and one of the earliest productions in Arabic on medicine).[5] It is not clear to what extent Deusing improved

[1] *Liber Medicinarum Particularium*, De Cura Catarrhi.

[2] Hyrti, *op. cit.*, 243, Cf. D. M. Dunlop, 'Joha Mesue and his Work', *Bulletin of the British Society for the History of Science*, I (1952), 213.

[3] Cf. D. M. Moir, *Oulines of the Ancient History of Medicine* (Edienburgh and London 1831), 4n.

[4] Most of the details which follow are from A. Hirach, *Bigrophisches Lezicon der hervorragenden Aerzte* (Vinna and Leipzig, 1886).

[5] See p. 36.

on the 11th century Latin version ascribed to Constantine Africanus. Deusing also composed a book of *Dissertations*[1] on various subjects including the unicorn, the bezoar-stone, mandrakes, barnacle-geese, etc. The sources of this were evidently to some extent Arabist. He also produced an annotated edition of the *Arabic Grammar* of Erpenius and a dictionary of medical terms, not to mention a Persian-Latin and a Turkish-Latin dictionary.

The third of this group was G. H. Welsch, a Bavarian from Augsburg, who studied at Tübingen and Padua, and practised at Augsburg, dying in 1677. With these names the study and practice of Arabist medicine, of the type approved at Padua somewhat earlier, still continued.

Peter of Abano has been dealt with here because he well illustrates the Arabic influence on Europe before it begins to ebb, but also because the effect of his teaching appears to have been felt at Padua, in the departments of philosophy and medicine, indeed we may say in general science, for several centuries. Reckoning the work of the Paduan school as part of the general movement, we have a period of as long as seven hundred years, from the 10th to the 17th century, during which Arabic science more or less directly influenced scientific development in Europe. No one probably would be prepared to say that this influence was always a good thing, but the same is true of the other great intellectual movements during this long period of time, scholasticism and humanism. The central fact which I have attempted to illustrate is that there was this Arabic influence, this Arabist movement, extending, it may be said, from the Dark Ages of Europe down to the Renaissance. By the time of the scholars last named, the medical men influenced by Padua, Arabism, in the sense in which we have been considering it, has worn rather thin, and they scarcely had successors. Since that time there have been other learned Arabist doctors, such as W. A. Greenhill, in England and elsewhere. Yet their interest has been not to interrogate nature with the guidance of Arabic sources, but rather to understand and evaluate what these sources contain relating to nature, guided by other criteria than the Arabic sources themselves provide. This is clearly a different activity from that of the mediaeval or Renaissance Arabists. This is history of science.

1 Groningen, 1659.

Deusing in the 17th century, as has been mentioned, left behind him in Latin dictionaries of Arabic medical terms and of the Persian and Turkish languages. These were never published, unlike his old fashioned medical works. They represent another development which was only beginning to be realized, the interest, that is, in the general culture, including the science, of the Eastern nations for its own sake, with which we are familiar today as Orientalism. It was in these directions and not along the traditional lines, as they were by then, that real progress was possible. This is now generally recognized. The historians of science and the Orientalists are in their way the successors of the mediaeval Arabists, whose once-famous names and half-forgotten achievements we have been trying to recall.

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